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VOLUME 7, No 5 MAY 1955

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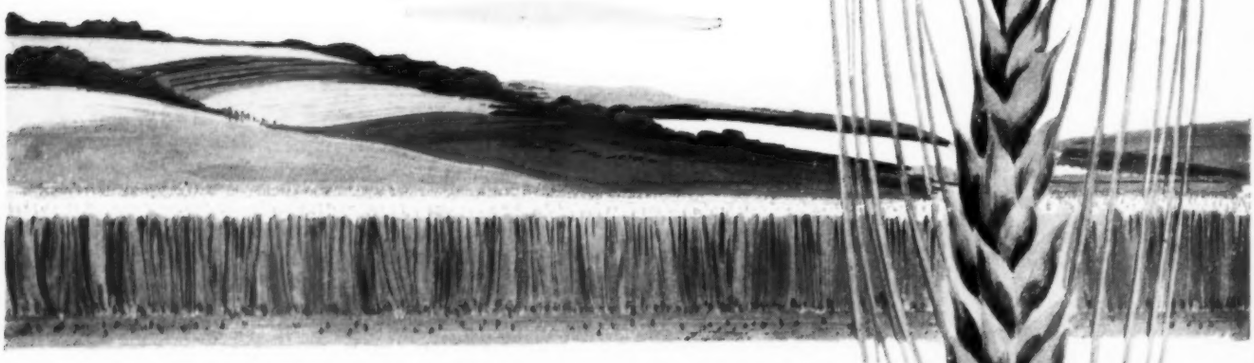

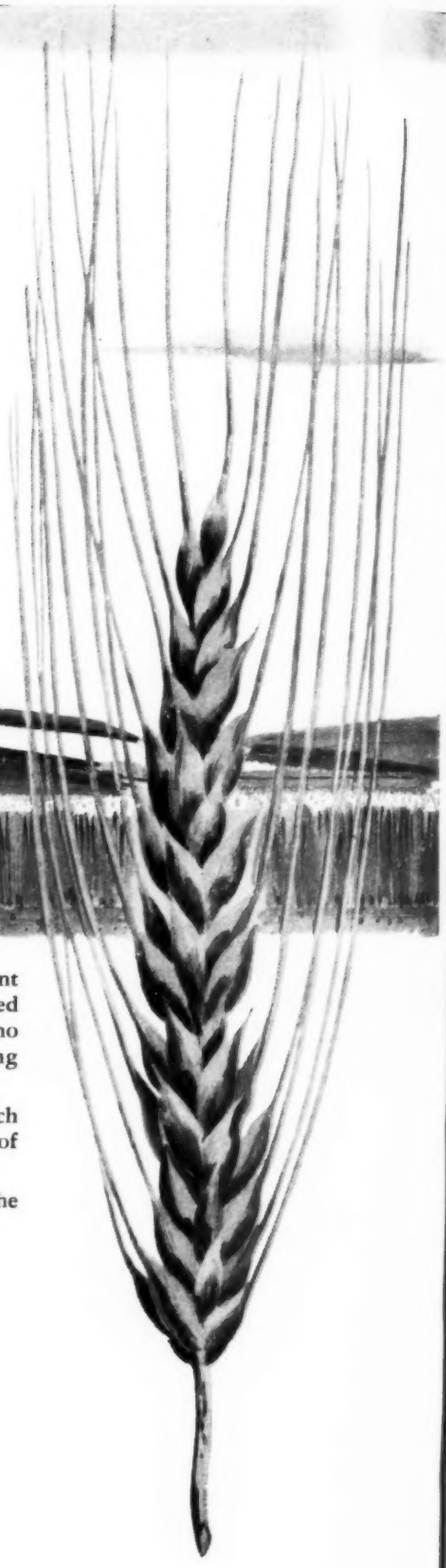

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WORLD CROPS

Vol. 7. No. 5 MAY 1955

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Editorial Comment

Farm guarantees

THE results of this year's annual review of the economic conditions and prospects of the agricultural industry held in accordance with Section 2 of the Agriculture Act, 1947, are contained in the White Paper (Cmd. 9406) published recently. The White Paper describes the production progress made by the agricultural industry during the past year, the changes in costs and incomes, the Government's production and guarantee policy, and gives the price guarantees determined for livestock and livestock products for the year 1955-56 and for crops from the 1956 harvest.

Unfavourable weather has resulted in a fall in the output of food from our farms during the past year. Net output for 1954-55 is estimated at 36% above pre-war, as compared with 55% a year ago. But for the weather, net output would have been higher than last year, since the increase in the output of pigs and fat cattle more than offsets a decline in the acreage under crops. Production of milk and eggs is estimated to be slightly above last year's.

Costs of production for review commodities have increased by about £39 million a year. Some £5½ million of this is already covered by the feed formula for pigs and eggs. A further £8½ million will have been met by the industry in the production of this year's output, leaving about £25 million increased costs to be taken into account for review commodities (£30 million for all commodities).

Net income for 1954-55 is forecast at £280 million, compared with £320½ million in 1953-54. When adjusted for normal weather conditions net income is estimated at £312 million for 1954-55, compared with £306½ million for 1953-54.

In spite of the reductions in price guarantees in the last annual review, increased efficiency has, as the Government hoped, enabled the industry to maintain its net income (on a normal basis), although unfavourable weather has reduced actual net income this year. Improvements in efficiency are assessed at about £25 million a year for review commodities. Continuing improvements in this direction should offset the effect on future net income of the known increase in costs, but the effects of the past season will continue to be felt well into 1955-56.

The Government reaffirms that in the free market conditions it is not practicable or desirable to set precise production targets for individual commodities. But the Government looks for the maintenance and increase of net output by (*a*) the production of more beef, mutton and lamb, (*b*) the maintenance of a large arable area and (*c*) the improvement of permanent grass and of grassland management generally. Development on these lines will help the national balance of external payments by reducing the need to purchase imported feeding stuffs.

The *Financial Times* comments: 'One of the first results of the return of a balance-of-payments problem has been the return of an emphasis on dollar saving. Home food production is the largest dollar saving of all. . . . The farmer may well find that in the best years, the years like 1954, there will be a tendency to cut down on the national support of farm production. But in the times of difficulty the need for maximum farm production, within reasonable limits of cost, will always be underlined.'

It is notable that the guarantees for wheat and coarse grains have been brought closer together by leaving the price of wheat unchanged and increasing the guarantees on barley and oats.

However, the industry should have the necessary resources to continue to develop its efficiency on the lines indicated. The value of the guarantees as a whole, both as regards price and production grants, has been increased by £28 million. The Government's general assessment is accordingly that, with the determinations now made, net income, on a normal weather basis and with the continued improvement in efficiency, should show some increase. The actual outcome will largely depend on the success of industry itself in bringing down its unit costs of production and getting the best out of the market.

Fertiliser granulation

A RECENT report from America (*Journal of Agricultural and Food Chemistry*, **3**, 2, 97, 1955) shows that fertiliser granulation is making rapid inroads into the conventional powdered form. It is estimated that 15% of the compounds sold in the United States is now granulated. To those accustomed to seeing America take the lead in new agricultural developments, this may make strange reading, for granulation has been far more widely established in Western Europe for several years, particularly in Britain, where 90% of the compound fertiliser production is granulated. It is possible that in Britain the optimum proportion has now been reached, that the residual 10% still manufactured in powdered form satisfies a market that will persist in wanting plant foods in a fine particulate size. It appears that American farmers are prepared to pay a little more for the refinement of granulation. In Britain, the huge conversion of 100% powder-form

production into 90% granular-form production, which took place over a period of about eight or nine years, was accomplished without any extra charges—at all times the prices of any specific compound for both powdered and granular forms were the same. This was no small achievement, for introducing the process of granulation involves heavy capital outlay.

As might be expected from our own earlier experience, the demand for granulated fertilisers is highest in the U.S. corn belt of the Mid-West. There is no doubt that dust-free and steady-flowing granular material is far better suited to combined seed-fertiliser drilling than is powdered material, and this practical advantage outweighs the more theoretical advantages claimed—better efficiency from better placement, more protection of phosphate from soil fixation etc. The *actual work* of drilling is made easier and speeded. There is more use of aircraft in fertiliser application in the United States, and this creates another specialised demand for granulated material. The flow of pellets through the air can be far better controlled than the flow of fine powders.

It may be doubted whether the demand by U.S. farmers will ever create a 90% market for granules. Smaller farmers are unlikely to be prepared to pay more for the changed physical form. Had a premium been charged in this country, it is improbable that more than a 70% share of the market would have been reached by now.

New Zealand paper industry

TO make full use of large exotic forests now maturing, New Zealand is quickly developing the greatest industrial project in her history. In the current issue of WORLD CROPS Mr. R. E. Murray presents a practical account of this development—the scheme provides for a yearly output of 75,000 tons of newsprint, 36,000 tons of pulp and 72 million ft. of sawn timber.

Two major concerns are engaged in the enterprise—the Government-backed Tasman Pulp and Paper Co. Ltd. and New Zealand Forest Products Ltd., a private concern. These two control more than half the Dominion's exotic forests, which now cover more than a million acres.

The two companies will have assets worth about £38 million. They have entered into an agreement for the development and expansion of New Zealand forest industries in an orderly, efficient and economic manner. The Tasman company will specialise in the production of newsprint and 'fine' papers and New Zealand Forest Products will expand the production of kraft pulp and paper for the manufacture of bags and containers.

Co-operation extends to the development of export markets, sales policy, shipping problems etc. Joint research is to be undertaken on timber, pulp and paper problems, and each company will make available to the other such information as it now has on those problems. Awards and conditions of employment will be considered jointly as they arise. The agreement also provides for the pooling of information on logging methods and costs, including the suitability of plant and equipment, and types of roads.

For some years now the New Zealand Forest Products company has been pioneering this field in New Zealand and has built up a large organisation. Recently its mills at Kinleith, near Tokoroa, turned out the first paper ever made in the Dominion from locally grown trees.

That marked the final stage of three processes to integrate the operations of the company's sawmill, pulp and paper plant installed at an overall cost of £7 million. The paper mill, a three-storied building with 75,000 sq. ft. of floor space, cost £1,350,000. Its equipment includes a large Walmsley machine imported from Britain. Most of the staff are New Zealanders, exceptions being a number of skilled paper operatives from England, two British shift foremen and one Australian.

This company is already exporting timber, pulp and paper products in steadily increasing quantities. These will be substantially augmented when the Tasman company's mills come into full production shortly. Located on the fringe of the 270,000-acre Kaingaroa State Forest, these mills, now in the course of construction, will be the largest in New Zealand. Close by, at Murupara, a new model township covering 265 acres and providing for a population of approximately 2,000 is now taking shape. Large numbers of houses have already been built and occupied; the remainder are scheduled for completion by 1955.

The development of the scheme will be watched closely by timber operatives from all over the world.

Disaster

AUSTRALIA'S economy has again been severely hit by the untimely floods which have created great havoc and laid desolate millions of acres of valuable country in New South Wales. Even as this issue of WORLD CROPS goes to press reports are still being received of further serious flooding in Queensland. The deep sympathy which everyone feels for the victims was voiced by Sir Winston Churchill and the British Government has informed the Australian Government of its desire to contribute a sum of £250,000 towards flood relief in New South Wales.

Losses of sheep and cattle, including many dairy herds, have been estimated at 500,000. In terms of currency this can be computed at £A3 million to £A4 million. Severe losses of lucerne and other fodder crops were sustained particularly on the inundated river flats. Emphasis, therefore, was placed

on relief fodder, supplies of which were sent by road, rail and air for stock that survived on high ground and which were without native pasture.

Export meat, butter, milk, cheese and wines are all products likely to suffer as a result of the floods and it will be many weeks before the soaked pastures recover. Despite their success in producing high-quality table wines the vignerons of northern New South Wales have been discouraged by the repeated tropical rainstorms.

The national press is urging that measures should be taken to mitigate the effects of recurring heavy floods and the State Minister of Conservation has proposed a conference of Commonwealth and State Governments to discuss finance for a scheme in the Hunter Valley district at an estimated cost of £A60 million. It has also been suggested that a national insurance scheme be established against flood and fire losses.

British crop yields, 1954

THE official estimates of average crop yields (England and Wales) last year were given recently. A dry sowing season, a wet and dull summer, and a savagely wet autumn might have been expected to reduce yields considerably more than the figures show. Wheat grain, at 22.6 cwt. per acre compared with 24 cwt. for 1953, represents, if correct, a triumph against adversity; so, too, does barley at 21.4 cwt. compared with 1953's 22.6 cwt. Potatoes averaged 7.9 tons per acre as against 8.7 tons for 1953; this is a remarkable effort indeed, for the 1953 yield set up a new record for this crop's average yield, and the 1954 figure is still equal to the previous record figure.

Some commentators have expressed doubts about the reliability of these estimates. They feel convinced that crops were more adversely affected by the bad weather. Certainly these declines in yield seem small, but the yield levels of 1953 may not be the proper basis for comparison. Our yields have been tending to rise year by year; what the 1954 weather took away was not merely the difference between 1954 and 1953 but also the further increases in yield that 1954 would normally have brought. With cereals the new high-yielding and stiffer-strawed varieties of wheat and barley are making more and more headway; a similar trend is somewhat less marked with oats. This may account for the fact that the 1954 oats yield was exactly 2 cwt. below 1953's average yield whereas the decrease for wheat and barley was 1.4 and 1.2 cwt. respectively. Thus, the expanding invasion of the new varieties helped to offset the weather's baleful influence. Similarly, with potatoes, steady increases in average yields should be expected; the acreage is in decline, which means that this crop is grown upon more suitable soils. Again a factor that should have made 1954's average yield a new all-time record helped to offset the yield-reducing effect of bad weather. In short, we cannot really measure the losses caused by so long a run of poor weather for we do not know the new yield levels that good weather would have brought; and the truth of this viewpoint is well evidenced by the fact that those crops whose yields fell the least (below 1953 levels) were those for which technical or other influences could have been expected to give significant increases in yield.

Problem in rice

THE fifth Commodity report on rice was published recently by FAO. A succinct account is presented of the relation that this cereal has with a rising world population and changing market economy.

One of the major post-war problems in the field of food and agriculture has been that of rice. For seven years great scarcity prevailed and large numbers of people went short of their favourite food or had to devote an exceptionally big part of their scanty resources to buying it at high prices. Over the last two years, the position has changed. The scarcity and the accompanying high prices have stimulated governments and farmers to devote great energies to growing more rice, and the same causes have reduced the effective demand for rice by inducing both governments and private consumers to turn to other foods, in particular other cereals.

Weather conditions too, in the past two years, have in the main been favourable to rice crops so that total production is now over 25% (25 million tons) higher than the pre-war average. Population in the main rice-eating region has indeed increased in a greater proportion than production within the area (25% as against 12%), but their supplies were augmented by a reversal in the direction of the rice trade.

Thus, rice ceased to flow from the Far East to other regions, whereas, on the contrary, America and Europe shipped rice to Asia. By the middle of 1953 all these factors had put an end to the rice scarcity in terms of a market economy; consumers, or—at first—the importing governments deciding on their behalf, were no longer anxious to acquire all the exportable rice at prices then prevailing. Exporting countries encountered increasing difficulties in marketing all their rice, particularly those which were slow in adapting themselves to changing markets, and stocks began to accumulate in their, generally inadequate, storage spaces.

This position was somewhat changed by two special factors which led to exceptional imports during 1954—the very poor crop in Japan, and the decision of the Indian government to build up reserve food stocks. Since these two exceptional features will probably not be repeated in 1955, exporters may be faced with a drop in import demand. They may thus encounter

difficult times while adjustments are proceeding and, in some countries, special consideration may need to be given to the problems of the individual rice growers Responses will vary with different conditions and according to views of the duration of such marketing difficulties.

Meanwhile, consumers, increasingly freed from restriction on their choice, may turn again in increasing measure to rice if prices are attractive, while the growth of population is providing a constant expansion of human requirements.

Plant genetics

IN a recent address given under the auspices of the Madras Agricultural Students' Union, Dr. S. C. Harland, F.R.S., Professor of Botany, Manchester, observed that plant breeding was practised even before the rediscovery of Mendel's laws, but in those times it was more an art than a science. Selection towards desirable ends from the economic point of view was the tool, but most of the cultivated plants of today have their origin in that way. Such a practice of domestication from wild types has, in fact, developed monstrosities which are able to survive satisfactorily only under the peculiar conditions of cultivation which are not usually obtained in nature.

In the wild state a balance is struck between the genetic constitution of the individual and the environmental conditions in which they grow, so that many might be found to progress well under circumstances which might look highly adverse. In the process of domestication man interferes with the genetic vitality conplexes of the plant that exist in nature and in trying to develop individuals with a high concentrations of genes, which determine the characters suited to his tastes and needs; he alters also the vitality complexes to which sufficient attention is not paid. As such, though certain characteristics are well developed in domestic plants, those which enable them to come up well in conditions obtaining in nature are lost sight of and finally reflected as serious defects. The stability that has been obtained through the long period of evolution in nature is interfered with and drastic changes occur during adaptation to the changed environment. This is clear from the fact that if the history of any domestic plant is examined it is found that the rate of mutation is higher than in the wild state.

To achieve success the plant breeder must be in intimate association with the plant. He must look to them as his own children, Dr. Harland observed. In any study the analysis must be based on clear knowledge of all factors influencing it as far as possible, coupled with close observation and not merely on accepted facts.

For instance in breeding for resistance to disease it is essential that the reaction of the host must be studied with reference to the differences in pathogenecity of the different races of the parasite. This necessitates the knowledge of plant pathology as a prerequisite, and it brings into the picture the heredity of host as well as the parasite.

The work on hybrid corn which has made great progress in America, has given us much in explanation of heterosis and it is generally believed that varieties of this cross-pollinated species which show heterotic vigour, go down heavily in vigour on inbreeding, owing to segregation of the genes conditioning heterosis. However, it was not always so, for, in his own experience in breeding maize in the West Indies, Dr. Harland said he observed varieties which lost little vigour on inbreeding. This must be due to the peculiar way in which selection has been practised by the native farmers and which had resulted in a proper balance of genes necessary for environmental adaptation and for maintaining the commercial qualities.

Cyprus development

IN planning its new development programme the Government of Cyprus will put the main emphasis on the need to increase efficient agricultural production. Developments in communications, such as roads, harbours and airports, will proceed in so far as they are necessary to cope with the increasing flow of trade, to reduce handling costs and improve distribution and export facilities.

The main trade problems facing Cyprus in the immediate future will be to dispose of agricultural products, whose cost of production is above world average costs; to import a larger volume of consumer goods from the most economic sources, in order to offset the rising prices of locally produced consumer goods; to offer some protection to established industries, and to improve the marketing of agricultural products consumed locally.

In view of the emphasis on increased local production and assistance to industry in development planning during 1955, and of the postponement of constructional works which are not directly productive, it has been decided to concentrate expenditure on schemes of agricultural development and on improvements to the main civil airport.

The proposed programme of development for 1955 is estimated at over £1½ million, almost double that of 1954. It includes £170,000 for agricultural development, including soil conservation. Most of the schemes will be completed by the end of the ten-year period ending in 1956. The new programme up to 1960 will place its main emphasis on the development of land use and on improving communications.

Maleic Hydrazide as a Plant-Growth Inhibitor

E. R. WEBBER

This article presents a review of the work done on the application of maleic hydrazide for the control of weeds. It summarises much important work undertaken in the U.K. by the East Malling Research Station and the Sports Turf Research Institute.

AN interesting development in the agricultural and horticultural world during the last few years has been the application of maleic hydrazide as a plant-growth regulator.

In 1949 it was discovered that this chemical, which is derived from the rocket fuel, hydrazine, possessed the property of being able to retard the growth of most kinds of plants. Its action seems to be a general one, since it retards trees, grasses and weeds of nearly all kinds to a greater or lesser extent. This suggests that its inhibitory action affects the fundamental metabolism of all vegetable matter. Indeed, several workers have shown that maleic hydrazide is an anti-auxin. Working along other lines, Darlington and McLeish found that maleic hydrazide was a promising tool in the study of plant chromosomes. It caused chromosome breakage, but this breakage, or splitting of the chromosomes, was unlike that of any other substance studied in that the splitting occurred in the heterochromatin segment only and offered some chance of controlled breakage. Most other chromosome-splitting chemicals, and *X*-rays, cause a random breakage.

A warning was given in 1951 that, since so many chromosome-breaking agents had so far proved to be cancer-producing, it was hoped that the agricultural use of maleic hydrazide would not be encouraged before suitable tests had been made.

In the few years since then many tests have been carried out, but the matter is not yet finally cleared up. There is certainly no positive indication of cancer-producing effects, but until more is known the manufacturers—in the United Kingdom at least—are not advising the indiscriminate use of maleic hydrazide.

When the present series of extensive tests are completed it is hoped that maleic hydrazide will bring benefits to farmers and growers as a means of improving the storage of root crops. In this respect it is worth noting that the U.S. Department of Agriculture has already given its approval to the use of maleic hydrazide on potatoes, although in the U.K. an official verdict has not been given.

Toxicity

Maleic hydrazide is not poisonous to humans and animals and can be handled without the need for special clothing. It is, in fact, far less toxic than DDT, which is itself now regarded as one of the less dangerous chemicals used in agriculture. Maleic hydrazide is a monobasic, organic acid manufactured from maleic anhydride and hydrazine. The white, crystalline powder is relatively insoluble in water, but soluble in alkalis with the formation of the corresponding salt.

Maleic hydrazide (suggested name 1:2-dihydro-3:6-dioxopyridazine and known to American authors as 1:2-dihydropyridazine-3:6-dione) is recognised under the trade initials of MH.

It is an inhibitor of growth, not a herbicide and, when used at the recommended dosages, can cause no lasting harm to plants. It is more effective if applied to plants when they are young than when they are old or dormant and seems to have little or no effect if applied to plants before they emerge above ground, though it has been proved that it can be absorbed by roots.

Since maleic hydrazide itself is soluble in cold water only to a very slight extent, the solutions for spraying are usually made up from the sodium, diethanolamine or triethanolamine salts dissolved in water. Other salts are being investigated. To these solutions a wetting agent is generally added at the rate of about 0.05% to increase the effective penetration of the spray.

Several formulations are being tested; the two at present showing promise in the U.K. are:

(*a*) MH 40%: a pale buff-coloured powder containing 40% (w/v) maleic hydrazide and other ingredients, including a wetting agent. The powder is readily soluble in cold water.

(*b*) MH 25%: a clear, pale, brown-coloured liquid containing 25% (w/v) maleic hydrazide and

Arran Pilot potatoes which received a pre-harvest foliar spray of 4½ lb. of maleic hydrazide per acre on 21 July, 1953, and were harvested on 28 August, 1953. They were stored in sacks. Photograph was taken on 24 May, 1954. Plots Nos. 6 and 7 did not receive maleic hydrazide treatment

other ingredients, including a wetting agent.

Effects on plants

Maleic hydrazide is absorbed slowly by plants for about 30 hours after application and is then translocated downwards during the next 10 or 12 days. The spray is taken in by the plant surfaces and affects the rate of growth subsequently. The action of the chemical is probably in reducing the activity of the naturally occurring plant hormones which stimulate growth. The duration of the dormancy period depends on the plant species and the amount of maleic hydrazide applied; it also depends to a lesser extent on the season of treatment, the age of the plant, the weather after treatment, the particular formulation used and other factors.

It might be feared that spray residue falling on the soil would have an undesirable effect on the micro-organisms of the soil. Tests, however, which were carried out using the monosodium salt of maleic hydrazide against the following micro-organisms (*a*) bacteria (*Staphylococcus*, *Bacterium coli*, *Bacillus subtilis*); (*b*) moulds (*Penicillium* spp., *Aspergillus* spp., *Mucor* spp.) showed that no inhibition was apparent at dilutions of maleic hydrazide from 1:100 to 1:10,000 against both surface and submerged cultures of these micro-organisms.

Any spray residue which falls on the soil is decomposed and seems to have no residue effect on the crops of the following season.

Control of grasses

There are many possible uses for maleic hydrazide in agriculture and commercial horticulture, but its most important use at present is the control of grass growth on roadside verges and similar stretches of coarser grasses, such as certain areas of cemeteries, churchyards, orchards etc. This is the only use advocated at the present by the suppliers of the chemical in the U.K.

It is important to stress that it is not recommended for lawns or fine turf. Fine turf grasses (*Agrostis* and *Fescue* spp. particularly) should not be sprayed with maleic hydrazide, as they appear to discolour easily compared with the coarser grasses, such as rye-grass, timothy and false oat.

The period of dormancy induced in the grass is, up to a point, related to the quantity of maleic hydrazide applied. Excessive amounts, however, cannot be used because the grass will be damaged and look unsightly. The maximum amount that can be applied in one spraying is 4 lb. of maleic hydrazide (active ingredient) per acre. It can be applied at the rate of 6lb. per acre when cutting is not possible and when two sprayings would be uneconomical, but there is a risk of some discoloration of the grass. It is more effective to apply two half-doses rather than one full dose.

Although maleic hydrazide has a powerful inhibiting effect on grass, its effect on weeds varies, and in most cases is less marked than on grass. Plantains are notably resistant. This difficulty of control can, however, be overcome by mixing one of the selective weedkillers, such as 2,4-D or MCPA with the maleic hydrazide spray. The mixed spray must be used immediately, particularly if the selective weedkiller is in the form of an emulsion.

Spraying

Spring is the best season for spraying and 3 lb. of maleic hydrazide per acre is recommended in early April, followed by a second spraying of 3 lb. per acre in mid-summer. This should give control right through the season. If only one spraying can be given, 4-6 lb. per acre should be applied, the period of inhibition being approximately 10-15 weeks.

Summer sprays are less effective than those of the spring, except where previous treatment has been applied. In the latter case the second 3 lb. per acre should be sprayed when the grass is beginning to resume growth about the end of June. If no previous treatment has been applied, 4-6 lb. should be used in summer.

The object of autumn spraying is to check the growth at the end of the season before the grass enters its normal winter dormancy, and also to delay regrowth the following spring. Treatment of 3 lb. per acre in September or early October is recommended.

Spraying should not be carried out in winter while the grass is dormant.

The object of using maleic hydrazide on grass is to reduce the necessity for mowing, which is an expensive item both for time and for labour. To produce the green swards for which the lawns and playing fields of the U.K. are so famed, regular mowing and rolling are necessary.

Trials carried out by Sutton and Sons, Ltd., of Reading, Berkshire, and also by the Sports Turf Research Institute at Bingley, Yorkshire, confirmed that the possibilities of using maleic hydrazide on regularly mown fine turf, such

Portion of hedge treated with maleic hydrazide on 5 June, 1953, and trimmed two weeks later. Photograph taken 10 weeks after trimming

as that of putting greens or bowling greens, were very limited.

It has been found that if grass treated with maleic hydrazide is mown frequently the combined effects result in damage and unsightly appearance. The most apparent difference between treated and untreated grass is the absence of flowering seed stalks in the treated areas. This alone can give a difference in height of 12-24 in. But even treated grass may grow to several inches unless it is cut, so that for maximum neatness without damage one cutting about 14 days after spraying is recommended. This cutting should not leave the grass shorter than 1½ in., preferably 2-2½ in.

Once the spray has been absorbed by the plants no amount of rain will remove it and absorption takes place over a period of about 36 hours. But any rain falling within those 36 hours will reduce the effect of the maleic hydrazide to some extent. In practice it is found that only if heavy rain falls within 12 hours of the treatment will the effect be seriously reduced.

Availability

In the U.S.A. several formulations of maleic hydrazide are available to the general public and advertisements appear in many horticultural journals advocating its use on edges of lawns, grass banks, ditches etc.

There is at present only one commercial brand available in the U.K. and this—marketed as a grass-growth regulator—is restricted temporarily for sale to responsible users such as county and borough councils. It is stated that there is no intention to supply this material to the general public, at least until much more experience has been gained in its use under the most widely varying conditions. In its present stage of development the suppliers do not think that maleic hydrazide is of much use for the amateur gardener's lawn and that the manufacturers of lawn mowers need not feel apprehensive.

Spraying should be done when the weather is suitable—if possible on a day when no rain is expected for at least 36 hours—but too much sun is not advisable, since the leaves are not then in a receptive state to absorb moisture. Ordinary hydraulic spray equipment should be used with, for preference, No. 6 discs in the nozzles and pressures of 75-200 lb./sq. in.

For small areas, or areas where it is not possible to use a power-operated machine, a 2-gal. knapsack sprayer is very convenient and 100-150 gal. of spray per acre should be applied.

Care must be taken not to apply too much spray at the commencement of the operation. This can be avoided if the machine is moving when the spray is turned on.

With the MH 40% formulation any lumps in the powder should be well crushed and the powder dissolved in a small proportion of the total spray volume and diluted to full volume with stirring.

The MH 25% formulation—a liquid—may be put directly in the spray tank, where it can be mixed immediately with water and stirred to ensure even dilution.

Although no special precautions are necessary in handling, any splashes of the concentrate should be washed off the skin immediately and inhalation of the spray drift should be avoided.

Effect on vegetables

Maleic hydrazide has also been used successfully to reduce the sprouting of potatoes in storage. Although official trials are going on in several parts of the U.K., it is from the U.S.A. that most of the information comes at present. The chemical is sprayed on to the plants before harvesting while the tops are still green or before the foliage has died appreciably. If the foliage is sprayed too early, there may be some loss in yield and a preponderance of small tubers. The tubers from the sprayed plants do not sprout and often show no signs of sprouting up to 12 months afterwards. Maleic hydrazide cannot, of course, be used where the potatoes are grown for seed.

Tubers from the sprayed plants do contain a slight residue of the chemical, but these tubers have been widely tested on animals and do not appear to have any harmful effect. The U.S. Department of Agriculture has sanctioned the use of maleic hydrazide in this connection.

The recommended rate of application is 3 lb. dissolved in water and applied at the rate of 100 gal. per acre.

Onions, carrots, parsnips, turnips and rutabagas have all been treated successfully in the same way, though with a slightly lower dilution of the chemical. For the onion crop the spray is applied between one and two weeks before harvest while the tops are still green and for the others about two weeks before harvesting. With sugar beet (and fodder beet) the maleic hydrazide helps to prevent the breakdown of sugar in the beet during storage as well as preventing sprouting at that time.

Untreated portion of hedge trimmed at the same time as the treated portion (*facing page*). **Photograph taken 10 weeks after trimming**

On the left is the untreated area showing the tall growth of grass. Areas on the right surrounding the gravestones were treated with MH 40% formulation at the rate of 4 lb. of active ingredient per acre, combined with a 2,4-D spray. Date of spraying: Mid-April 1954. Date of photograph: Mid-June 1954. (Note: there is a *mown* lane between the treated and untreated areas)

Effect on cereal crops

Experiments have been taking place on controlling the growth of cereal crops. Most of these plants are much more sensitive to maleic hydrazide than root crops or grasses and any treatment which de-tassels them also causes severe stunting and possibly death.

It has, however, been used fairly successfully in Canada for the selective control of wild oats in cereal crops.

This control is made possible by the fact that some cereal crops reach the heading stage of growth at a different time from that of the wild oat (*Avena fatua*).

In 1952, at the Central Experimental Farm, Ottawa, wild oats and cereal crops were rendered almost completely sterile by spraying before heading with a solution of maleic hydrazide plus a wetting agent at the rate of 1 lb. of active ingredient per acre. The heads emerged, but they contained little seed.

However, a later spraying with the same amount of chemical was given at a time when the wheat and barley had been in head for six days, but while the wild and cultivated oats were still only in the ' shot blade ' stage. This spraying caused almost complete sterility of the wild and cultivated oats, but did not materially affect the yields of barley and wheat. Only 9% of the barley heads and 16% of the wheat heads were found to be sterile compared with almost 100% of the wild and cultivated oats.

A germination test was made with the seeds collected from the plot which received the later treatment and it was found that the germination of the barley seed was not affected by the treatment. Of wheat seed from this plot, however, only 9% germinated compared with 92% germination of the wheat seeds from the untreated plots.

Only a very few wild-oat seeds were obtained and of these the germination was 6.9% compared with 62.4% germination for the wild oats from the untreated area.

More exhaustive tests are being carried out at various experimental farms scattered throughout Canada—chiefly in areas where wild oats are a serious weed problem—and it is possible that maleic hydrazide may prove useful in the control of these wild oats.

Effect on tobacco

On tobacco, maleic hydrazide has been used to control sucker growth. In America it was found that 20 ml. of a 1% solution as the diethanolamine salt sprayed on to the upper 6-7 leaves of Havana seed tobacco after topping gave satisfactory sucker control with no significant effect on yield, quality or burning properties of cured tobacco leaves.

On Turkish tobacco an application of 0.4% and 0.8% maleic hydrazide to flower buds, which were just forming, stopped all elongation, killed the flower buds and prevented axillary bud development. The top leaves became as enlarged as the lower ones.

Thus it would seem that maleic hydrazide appears to inhibit the growth of the suckers while allowing existing leaves to increase in size.

Effect on soft fruits

Maleic hydrazide is being tested on soft fruits with a view to delaying blossoming and, in strawberries, also to delay runner production. Work is being done on this in both the U.S.A. and the U.K. Much of the investigation in the U.K. has been carried out at the East Malling Research Station and a recent report on raspberries states that Malling Exploit raspberries were sprayed at ' bud burst ' with 750 p.p.m. of maleic hydrazide and subjected to low-temperature conditions at the ' green bud ' and the ' open flower ' stages. The growth of many buds was delayed, particularly those most advanced at the time of spraying. Some buds were killed, however, and the secondary ones which replaced most of these did not compensate for the initial damage. It was found that (*a*) frost damage was increased where there was strong inhibition of growth, (*b*) a certain degree of frost resistance was induced in buds which were not too strongly inhibited and (*c*) the delay in blossoming tended to reduce frost damage. The net effect, however, resulted in a reduction in the total crop, so that at present it is not a practical commercial proposition.

Other applications

Maleic hydrazide has been tested on various trees, applied either by injection into the limbs, or into the soil around the roots of young trees, or sprayed on to the leaves. These tests were undertaken in the hope that blossoming would be delayed enough to escape spring frosts. It has been suggested also that dwarf trees might be produced in this way. The tests included apple, cherry, peach, spruce,

hemlock, pine and larch, but further work is necessary before results can be predicted.

Another interesting use is in the control of the growth of hedges. In 1950 Dr. J. E. Knott, of the University of California, began some experiments on a *Pyracantha crenulata* hedge and found that a 0.5% solution of maleic hydrazide checked growth for at least a month and retarded growth for several months afterwards. No injury to the foliage or to partially developed berries was noticed.

In 1953 several California privet hedges were sprayed and two treatments were found to control new shoot growth for almost the whole season and the hedges needed trimming only once during the whole summer. Experiments at the New York Botanical Garden showed that treated privet needed only one trimming during the season, whereas the untreated needed three.

In England, experiments showed that privet and thorn could be treated successfully, but that elder was rather badly damaged.

Other work has been done with flowers. At the University of Missouri unopened rose buds dipped for a minute into a maleic hydrazide solution had the opening of their buds delayed to such an extent that the flowers could be kept in normal cold storage for 2-4 weeks. The treated flowers also lasted longer in the home.

At Purdue University it was found that maleic hydrazide sprayed on to potted chrysanthemums checked growth at the tips and promoted development of the laterals. This treatment gave the same result as ' pinching out ' the buds and it is thought that the successful application of this method could reduce labour costs for the commercial chrysanthemum grower.

During the past three years much work has been done in Canada and the U.S.A. with maleic hydrazide as a herbicide on couch grass and twitch or quack grass (*Agropyron repens*). Early experiments consisted primarily of applications at varying dosages which gave somewhat negative results.

More recently some workers have combined maleic hydrazide application with tillage and have obtained varying degrees of control. General information would indicate that applications of from 4 to 16 lb. of maleic hydrazide to the foliage of couch grass, followed by ploughing or other form of tillage, will give up to 95% control. The tillage should be done not later than two weeks after spraying and it would appear that vegetable crops can be planted immediately afterwards with no detrimental effects.

Other possible uses of maleic hydrazide not mentioned in this article include the prevention of bolting in lettuce and spinach, the inhibition of secondary growth of cotton, blossom thinning of peaches and perhaps other fruit, increased seed production on small-seeded legumes and the pre-harvest application on apples to improve storage stability.

It would seem, therefore, that maleic hydrazide is on its way to becoming established as a growth regulator for use on areas of coarse grass and that it has many other interesting applications which, in time, may prove useful to the farmer and horticulturist.

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Photos: Whiffen and Sons Ltd.

Variety Trials of Red Clover

It has been suspected for some years that there has been some mis-description of seeds of red clover passing in commerce in the United Kingdom. This suspicion was borne out by check growing-on trials of red clover seed carried out by the National Institute of Agricultural Botany from 1949 to 1951. In 1952, the Ministry of Agriculture and Fisheries arranged with the Official Seed Testing Station for 42 control samples drawn by the Ministry's inspectors to be grown-on in order to check varietal descriptions after being tested in the normal way for purity and germination. The results of the variety tests revealed a number that were wrongly described, as indicated below.

Double-cut Red clover (Broad Red Clover). Eleven samples were received described as either red clover, English red clover or double-cut red clover. These all belonged to the double-cut type as indicated by their early spring growth and aftermath.

Single-cut Red Clover. Five samples were described as single-cut red clover; seven described as late-flowering red clover were also treated as being in this group. The majority of these samples were similar in behaviour although four were later flowering than the true single-cuts, resembling the true late-flowering varieties, and two other samples appeared to be mixtures of double-cut and true flowering types

Late-Flowering Red Clover (Montgomery types). Nineteen samples were included in this group. The trial results indicated that 14 of these were correctly described; two, however, were much earlier being similar to the double-cut type, while two others closely resembled the single-cuts.

Type Descriptions. Although this experiment set out to discover whether red clovers were being obviously misdescribed or were of mixed origin, the results also showed quite definitely that there is considerable confusion as to the correct descriptions to be applied to the various classes of red clover. It is therefore recommended that the following classes and descriptions be adopted in the United Kingdom.

(a) Kind of seed	*(b) Variety*	*(c) Country of origin*
Red Clover	Double-cut or Broad Red	England, New Zealand, etc.
Red Clover	Single-cut	England, etc.
Red Clover	Late Flowering (Montgomery, S.123, etc.)	Wales, England, New Zealand, etc.

A Citrus Industry for Zanzibar

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Coconuts and cloves are the main agricultural products of the Zanzibar Protectorate, but, as the author suggests, the establishment of more lucrative secondary crops such as citrus would assure a firmer foundation for the Protectorate's economy.

THE Protectorate of Zanzibar is famed for its clove crop, the islands of Pemba and Zanzibar producing the greater part of the world's supply of this valuable spice. The Protectorate also makes a useful contribution to world supplies of copra and coconut oil. But, beyond these two main crops, its agricultural exports are negligible. A fair proportion of Zanzibar's food needs, both plant and animal, are home produced, but its heavy list of essential imports is balanced almost entirely by exports of clove and coconut products. Thus, in 1953, out of a total value of domestic exports of £7,171,549, as much as £7,089,733, or nearly 99%, derived from clove and coconut products.

Coconuts, in spite of the very poor financial return per acre obtainable from this crop, suit the Zanzibar grower in many respects. They can be produced without a very high standard of husbandry and, although prices for copra and coconut oil are sometimes very low, the demand in oversea markets is steady and dependable.

Clove prices, on the other hand, have reached phenomenally high levels in recent years and the Zanzibar farmer has never been more enthusiastic about clove planting than he is at the present time. This confidence in the future of cloves, in spite of the publicity given in recent years to clove diseases and to other problems connected with this crop, is shared by the authorities and every encouragement is being given to the maintenance of clove production as the Protectorate's major industry. This was recently described by Williams and Briant (WORLD CROPS, 5, 414, 1953).

Nevertheless, such an unbalanced dependence on two crops cannot be faced with equanimity and the strongest encouragement is being given to the development of subsidiary export crops. These new crops, it must be emphasised, are not intended to supplant cloves and coconuts, but to supplement them.

Suitable crops

The crops which have been selected as most suitable for Zanzibar and which are being encouraged at present are chillies, derris, cacao, coffee and citrus. This article describes the manner in which the development of a small citrus industry is being undertaken.

Zanzibar citrus fruits, especially oranges and grapefruit, have a well-deserved local reputation. In spite of rough handling and inefficient packing, Zanzibar oranges are sold at a premium in the East African coastal and inland towns. With the growth of these towns and the rapid development of Kenya and Tanganyika, expanding markets for Zanzibar fruit are confidently expected. With improved packing and careful selection of properly harvested fruit, markets as far afield as Aden or India could also be considered.

Finance

In 1951 a substantial grant from Colonial Development and Welfare funds was made to finance a scheme for the development of this small citrus industry. The object of the scheme is to extend the planting of oranges, grapefruit, mandarins and limes. The planting of stocks began at the end of 1951 and the first issue of planting material to the public was made in 1953. The third and last issue will be made in 1955, when this part of the scheme will be completed.

Before the commencement of this special scheme work on citrus fruits in Zanzibar had been in steady progress for several years and there was a valuable foundation of knowledge on which to build. Since 1935 large numbers of local orange selections budded on a variety of stocks had been yield-recorded and the best type of local oranges chosen and multiplied to

Budded mandarins, two and a half years in the field. Dole 20-acre pilot plot

form a source of budwood. At the same time, the necessary nursery techniques had been learned and a nucleus of trained staff was available which could be rapidly expanded. Imported grapefruit varieties had also been investigated, and selection amongst local seedling mandarins had provided useful sources of budwood.

The incidence of a mild form of *tristeza* in Zanzibar some years previously had led to the rejection of sour orange as a stock and to the successful use of rough lemon stocks for oranges and grapefruit. When the present scheme was first planned it was intended to issue seedling limes, but, in view of possible trouble from lime die-back disease, it was later decided to bud the limes also on rough lemon stocks. Subsequent growth and vigour of these budded limes has been prodigious and amply repays the trouble of budding. Mandarins have proved rather difficult to bud, but results have improved with experience.

Although oranges, grapefruit and mandarins are intended mainly for export as fresh fruit, limes were included in the scheme with a view to establishing a lime-oil industry in Zanzibar. The local lime greatly resembles the West Indian lime and samples of oil distilled from Zanzibar limes were examined and tested by U.K. manufacturers through the Colonial Products Laboratory and the results gave the assurance that Zanzibar lime-oil has the true West Indian flavour and would be generally acceptable to the trade.

The next step in the plan for a local lime industry was to prepare legislation to regulate the manufacture of lime-oil by prohibiting its manufacture except under licence, and also to enable a local organisation known as the Clove Growers' Association to manufacture lime oil for an initial period of five years. This association has the facilities and staff necessary for the proper preparation of high-quality oil and this should enable the new industry to become properly established.

Essential features

The essential features of the scheme are the distribution of free planting material and a bonus payment for four years to enable growers to maintain their young orchards in good order until they come into bearing. This bonus is dependent on good husbandry. The minimum size of orchards which can be established through the scheme is 1 acre, since it is considered that smaller areas might not justify the cost of proper maintenance and efficient harvesting and marketing. The bonus payments will amount to approximately £22 10s. 0d. per acre payable over four years and it is intended to establish some 700 acres of citrus, mostly oranges and limes, under the present scheme.

Budded oranges, two and a half years in the field. Dole 20-acre pilot plot (Note: windbreak of *Cassia siamea*)

At the present time, after two of the three annual issues of planting material have been made, the progress of the scheme is well up to schedule. All of the grapefruit, approximately 70% of both oranges and limes and 30% of the mandarins, which have lagged behind schedule owing to budding difficulties, have already been planted out. It is anticipated that by early 1955 the planting programme will be completed.

The most serious setback to the scheme so far became apparent at the

Remarkable growth of limes, budded on sour orange, after two and a half years in the field. Dole 20-acre pilot plot

end of 1953, when an outbreak of wither-tip disease (*Gloeosporium limetticolum*) occurred in several areas. This disease had not previously been known to exist in East Africa and it was as unexpected as it was unwelcome. It is impossible to say to what extent wither-tip will restrict lime production. Its serious potentialities are fully appreciated, although, so far, its attacks have not adversely affected the vegetative vigour and growth of the trees. Many of the lime orchards have been established in the drier parts of the island and it is hoped that the effect of the disease, which thrives under damp conditions, will be less serious in these areas. Moreover, as the lime crop is normally produced in marked flushes, it should be possible to protect the crop by spraying when the fruit is set. For these reasons it is intended to carry on with the programme in spite of the presence of the disease.

The general level of maintenance of the newly established orchards has been fairly satisfactory. Some keen agriculturists now have young plantations almost equal in excellence to the 20-acre demonstration plot which was established on the Government Experimental Station at the start of the scheme as an example to growers. Many citrus growers have had serious difficulties, however, in obtaining sufficient labour during clove harvests, when all available labour is always attracted to the clove areas. There have also been several disastrous losses of young citrus orchards due to grass fires in spite of repeated advice to maintain fire traces.

Budded grapefruit, three and a half years in the field. Dole 20-acre pilot plot

Marketing

So far, notwithstanding difficulties and setbacks, there is every reason to believe that the scheme will prove a success. Lime-distillation machinery is now being assembled and distillation on a small experimental scale may be possible in 1955. Once a profitable and reliable market for citrus products is established, it is expected that other growers will be attracted to this crop and a useful minor industry will have been created.

The importance to Zanzibar of such new minor agricultural industries is very great. Many plantation owners, who have experienced losses of clove trees from 'sudden-death disease' and who do not wish to replant cloves, have turned to coconuts as an alternative crop. But to substitute coconuts, with a gross annual return of about £10 per acre, for cloves, which have a gross annual return of about £80 an acre, is not in the interests of either the landowner or the Protectorate. It is only through the establishment of more lucrative secondary crops, such as citrus, that a better balance will be achieved and the Protectorate's economy given a more stable and secure foundation.

European Co-operation in Agricultural Research

The newly formed Sub-Committee on Agricultural Research of the European Committee of Agriculture met for the first time recently in London. The meeting was attended by 24 representatives of 17 European governments. Mr. van de Plaasche, Director General of Agriculture for the Netherlands, was elected chairman and Sir James Scott Watson, Chief Scientific and Agricultural Adviser to the Ministry of Agriculture, is vice-chairman.

The sub-committee was established by the FAO European Committee on Agriculture at its sixth meeting in Rome in June last year. It will be concerned to see how the best use can be made of the resources available for agricultural research in Europe; and it is expected to consider the development of a broad programme for the co-ordination of agricultural research among European member countries of FAO.

The meeting, which lasted four days, was opened by Dr. F. T. Wahlen, of Switzerland, who is Director of the Agriculture Division of FAO at its headquarters in Rome. Prof. Braconnier, Director of the National Institute of Agricultural Research in France and Chairman of the FAO European Committee on Agriculture, also addressed members.

Myxomatosis

Following the ever-increasing number of articles on this subject, a report was recently received that the viability of the disease seems to be diminishing in certain districts of the British Isles. In an area of North Hampshire, which was completely free of rabbits for some months after the introduction of myxomatosis, it was confirmed that rabbits are again appearing and seem to be particularly healthy and virile.

The Lelydorp Project: A Pilot Scheme for Land Development in Surinam

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The Lelydorp Project was envisaged some years ago and has developed rapidly since then. Its ultimate purpose is to demonstrate the agricultural and economic possibilities of the independent middle-class farm in the Old Coastal Plain district of Dutch Guiana.

EVERY year figures are published by FAO about the world food situation. These figures indicate an extremely low standard of agricultural production and nutrition in many regions of the earth. Moreover, no improvement of any importance has appeared lately in the critical food situation.

The land is least productive in the tropics. There are various reasons for this. In the first place the soil, as a result of leaching, is generally less fertile than in the temperate zones. Moreover, in tropical agriculture natural disadvantages such as weed growth and plant diseases are felt more strongly.

Furthermore, lack of capital bars the way to better equipment of farms and the purchase of machines and artificial fertilisers; and, finally, the low standards of education and organisation are serious handicaps for any attempts to improve agricultural development. Consequently, the agricultural production in the tropics is considerably lower than in the temperate zones. The yield of cereal crops per hectare (ha.), for instance, is often not more than half of that in the Netherlands, while for tuberous crops and pulses the differences are even greater.

Taking into account the fact that several tropical areas are densely populated and that this population, due to improved hygienic care, is still increasing, it is obvious that a very large part of the world population is constantly suffering from malnutrition.

Farming is the backbone of welfare in most tropical under-developed countries and farm production in these countries is low. Extension of agricultural 'know how', provision of capital and equipment, and better farm management systems would make it possible to raise the level of productivity considerably in these areas. Therefore, in several tropical countries, including the Caribbean region, careful attention is given to the problems of farm production and farm management.

The project is named after the village Lelydorp and the conditions in the region around the village may be considered typical for those of the Old Coastal Plain.

Agricultural conditions in Surinam

In general, the natural conditions in Surinam are favourable compared with those in other tropical areas.

Along the coast stretches a broad plain, which consists mainly of heavy, rather fertile clay soils and covers an area of about 1,600,000 ha. However, most of this 'Jonge Kustvlakte' (Young Coastal Plain) lies below high-tide level, and therefore requires to be drained (impoldered) before being used.

Further inland the Young Coastal Plain merges into a sandier, much less fertile formation of greater geological age, which consists of marine sediments but is mainly situated above high-tide level. This is the so-called Old Coastal Plain, which covers an area of about 450,000 ha.

The two coastal plains occupy together only one-seventh of the surface of Surinam. The remainder, the hilly, predominantly forested hinterland, has so far been little explored; its agricultural value is not highly estimated.

An agricultural census is in course of execution. According to the latest data available from the Surinam Report for 1949, it can be assumed that more than 19,000 lots of land, with a total area of about 64,000 ha., have been distributed for agricultural purposes, of which, however, only 19,000 ha., or 30%, have actually been brought under cultivation.

Zebu cows, two and a half years old

Cocoa under forest shade planted January 1952

Same field after thinning out shade trees

In addition, the plantations at present under exploitation cover an area of over 26,000 ha., of which about 7,000 ha. (only 27%) have been brought under cultivation. The economic position of these plantations is not particularly favourable, owing to shortage of labour and to high cost prices. The estates need economic reorganisation and experiments are actually being carried out to make more effective use of technical modernisation.

The average size of landholding among the small farmers of Surinam is less than 3.5 ha., of which about only 1 ha. per family is under cultivation.

Rice covers the greater part of the agricultural area of the country. In 1949, 17,000 ha. had been planted with this crop, cocos covers an area of about 2,500 ha., then follows coffee (2,300 ha.), citrus (2,000 ha.), sugar (1,300 ha.) and bananas (1,400 ha.); moreover, about 2,000 ha. of pulses, maize, groundnuts etc., had been harvested as so-called 'second crops', partly on rice fields.

The old coastal plain

Soil

The Old Coastal Plain is an ancient marine deposit which runs parallel with the present coastline of Surinam, as a more or less fragmentary 'second belt'.

Two types of landscape may be distinguished in the Old Coastal Plain, both of which indicate its marine origin. In the north there is the predominantly sandy, somewhat undulating, old offshore bar landscape, and in the south the old tidal flat landscape, in which silty loams and clays play the principal part.

For the entire area of the Old Coastal Plain a large-scale map gives the general outlines of the pedological situation (V. D. Eyk and Hendriks, 1952), while for the Lelydorp Project, and its surroundings, a detailed soil survey was carried out (Hendriks and Glavimans, 1953).

In the slightly undulating, sand-bar-like country in which the Lelydorp Project is situated, the relief of the land plays an important role in pedology and agriculture: with respect to pedology, because the relief caused the formation of widely differing soil series; with respect to agriculture, because the nature of this terrain, in regard to drainage possibilities and the danger of erosion, necessitates the application of different forms of agricultural practices.

Almost all the Lelydorp soils are poor; contents of phosphorus and potassium, in particular, are low. The content of organic substance in the valley soils is fairly high, as it is also in the swamp soils. The pH value is lowest for the plateau soils, namely 4.8; for the remaining soils it lies between 5.0 and 5.4.

The territory has been provisionally divided according to agricultural value:

Arable land: preferably on the areas of ridge soil, which are sufficiently flat to prevent erosion.

Pasture land: preferably in the valleys.

Land for tree crops: especially on the slope and ridge soils.

Rice land: in small swampy areas and in the valleys where irrigation has proved to be possible.

The sequence of soils with different land-use possibilities has necessitated a system of mixed farming. This has the advantage of a more even spreading of risks for the farm and also a more even distribution of labour over the year.

Farm practices in this region are mainly concerned with the conservation of soil fertility. For this reason, the tree crops are undersown with kudzu, which, by its dense cover, protects the land against erosion and increases the humus content of the topsoil. For the same reason farmyard manure is applied to the arable land and the banana groves.

The pasture land is in itself insufficient to the cattle stock; an important part of the feeding is provided by fodder grasses and kudzu (albumen content, 18-20%).

Water

As was indicated above, the natural drainage conditions of the land are also an important factor in its agricultural use.

The drainage possibilities are determined by the numerous large and small swamps and marshes occurring in the Old Coastal Plain. Drainage can only take place to swamp level. For instance, to the north of the Lelydorp Project lies an extensive marsh covering 2,000 ha. The swamp level of this marsh varies in the dry and wet seasons between 9.60 m. above S.P. (Surinaams Peil=Surinam standard level) and 10.40 m. above S.P., as compared with 10.00 m. to 16.50 m. above S.P. for the surrounding country.

Efficient drainage to swamp level can be achieved by cleaning creeks and watercourses which become choked by vegetation. Additional drainage canals are necessary in order to drain the flatter parts of the region.

Vegetation

The original vegetation of the dry and marshy soils in the Old Coastal Plain consisted of more-or-less dense rain forest. On the ' white ' soils this vegetation merges, *via* savanna woodland, into a shrub wilderness. Swamps are generally covered with grass (Cohen and V. D. Eyk, 1953; Heinsdijk, 1953).

A part of these territories was cleared in former years by plantation owners or natives; after desertion of the fields, the land was covered again with a forest growth of secondary nature.

A field in the rotation-research area with young cassava

A good picture of the vegetation in the Old Coastal Plain can be obtained from the aerial photographs (scale 1 : 40,000), which are now being used by the Central Bureau for Aerial Surveys for the compilation of vegetation maps. For the Lelydorp Project, vegetation conditions before clearance have been recorded on a more detailed map.

Land use

The present situation

In order to obtain a clear picture of the present situation, an agricultural census was carried out in the vicinity of Lelydorp. The intention is to follow up this census by a more detailed analysis of the farm management in this area.

Each of the rented plots covered by the census had an area of 3-4 ha. In order to characterise the types and the intensity of farming for the different population groups in this region the figures in Table 1 are given.

The Creole farms consist predominantly of tree crops, chiefly cocos, followed by citrus and, in the last few years, some cocoa. Cassava, bananas and maize are planted between the trees.

The Hindu farms are mainly based on wet cultivation of rice, small quantities of cocos, citrus and vegetables as kitchen-garden crops. In addition, cattle rearing (milking and draught cattle) is important.

The Javanese farms are purely compound plantations, on the kitchen-garden scale, in which coffee, cocos and various fruit trees find a place; besides these, rice, cassava and pulses are grown in very small quantities.

In spite of the present low farming standard, some of the better farms indicate that agriculture in the Old Coastal Plain can offer reasonable prospects provided the allocation of the land is carried out correctly, the soil is used in a suitable manner, the set-up of the farms is adapted to natural conditions, some capital is available and the farms are expertly managed. It is on the basis of these expectations that

TABLE 1

Average	*Creoles*	*Hindustani*	*Indonesians*
Size of holdings	4.0 ha.	3.2 ha.	3.0 ha.
Under cultivation	33%	51%	12%
Number of people per holding ..	4	8	4
Head of cattle	0.9	4.8	0.6
Number of poultry	14	18	7

The slightly undulating landscape at Lelydorp; the land is cleared and covered with kudzu. In the background the forest is left for cocoa

the Lelydorp Project has been launched as a pilot scheme in the Old Coastal Plain.

The Lelydorp project

The development scheme

The Lelydorp Project as a land development scheme started its activities in the last months of 1950. Its ultimate purpose is to demonstrate the agricultural and economic possibilities of the independent middle-class farm in the Old Coastal Plain.

The site of the project, only a few kilometres off the main road from Paramaribo to the airport at Zandery and about 25 km. from the capital city, is very favourable for a development scheme. Furthermore, enough labour was available in the vicinity for the reclamation and cultivation operations on the future settlement. The site chosen for the project represents a reasonable picture of the natural conditions existing in the northern part of the Old Coastal Plain.

Originally a highly ambitious project was planned in order to bring under cultivation, in a relatively short time, a great area of jungle on the plain (Langguth, Oliviera and Van Lier, 1950). But after some time it was clearly indicated by experience that, in the first place, it was necessary to obtain the requisite knowledge on a more modest scale before carrying out a large-scale operation. The soil pattern, as well as the natural drainage conditions, proved to be extraordinarily varied and complicated, and insufficient knowledge had been obtained regarding the most suitable agricultural utilisation of these varying soil series and the farm type best adapted to conditions in this region.

It was therefore considered useful also to include smaller holdings of 8 and 5 ha. in the experiment and, owing to the good growth of fodder grasses, it seemed desirable to make provision for farms on which (intensive) cattle rearing would occupy a prominent place.

According to details given below, by the end of 1954 35 farms will have been parcelled out, namely 15 farms of 11 ha., eight of 8 ha., seven of 5 ha., and five cattle farms, each 10 to 15 ha. in area. At the same time, an area of 60 ha. will have been planted mainly with oil palms as reserve, which area will, if necessary, also be allocated as farms. Besides, 60 ha. have been permanently earmarked as experimental fields for research purposes. From this it will be seen that, excluding forest reserves, buildings, roads, creeks, swamps etc., the directly productive area of the Lelydorp Project will amount to 450 ha.

Land clearance and organisation of the farms

At first, land clearing and subsequent cultivation took place more or less haphazardly, a fact which caused some difficulties when the land was parcelled out. When pedological and topographical maps became available, it was possible to consider the future utilisation of the land before clearing it.

Most of the clearance was done by axe and fire. Deforestation with heavy mechanical equipment, such as bulldozers, proved fatal to the texture of the soil and the conservation of the humus.

Parts of the forest which were meant as a cover for shade-needing crops, such as cocoa and coffee, were not felled wholly, but only thinned out selectively.

Immediately after clearing the remaining forest, a first crop of maize or beans, together with green manure crops, was sown in those parts of the area reserved for tree crops. Kudzu was used as a ground cover for the future oil palm, citrus and cocos plantations, and *Crotalaria* for cocoa grown with banana trees as a temporary cover crop. The future pastures were planted immediately with grass and all stumps of trees were dug out from fields destined for use as arable land.

The agricultural use of the land in regard to the complicated soil pattern, and the slopes and the drainage conditions, required careful consideration. Also the location of the farmhouse, cattle shed and water well had to be considered.

The average 11-ha. farm comprised 3 ha. of cocoa, 3 ha. of oil palms, 1 ha. of cocos, 1 ha. of citrus, and a total of 3 ha. for ploughland, pasture and farmyard. Each farm was stocked with eight cows and four pigs. In determining the organisation of the farm in regard to the area allocated to different crops and the number of cattle, an estimation was made of the labour requirements of different farm activities. For the same purpose a tentative prospect was made of the future market position of different farm products.

After the farms were completely set up, they were kept for another full year under the control of the central management until the planting could be considered successful and the cover of green manure crops had closed. They were then handed over to their future holders.

By the end of 1953 the area of land under cultivation in the Lelydorp Project was as shown in Table 2.

Furthermore, 125 ha. of bananas and 24 ha. of pineapples had been planted

as a temporary catch-crop between perennial crops and on future ploughland.

TABLE 2

	ha.
Oil palms	115
Cocoa	59
Cocos	32
Coffee	3
Oranges	18
Grapefruit	9
Lemons	8
Arable land	60
Rice	13
Pasture	65
Compounds	16
Reserve	23
Total	421

Costs regulations and expectations

It was not considered right to make the farmers in the Lelydorp Project settlement defray all the expenses connected with the settlement.

The farmers were only charged for the cost of clearing the land, making it ready for cultivation and planting it, together with the cost of farmhouse, cattle shed and the livestock placed at their disposal.

Since the planted crops require most attention in the first and second years, the farms are kept under central management for about one year after planting before being allocated. Thus investment costs were increased, so that the farmers were charged fl. (Dutch) 20.000, fl. 15.000 and fl. 10.000 on receipt of their holdings of 11, 8 and 5 ha. respectively. These farms will continue to cost money, for they cannot be expected to show a profit until the fourth year when the tree crops begin to produce. In the first few years there will probably be no profits, so the farmer will receive a fixed weekly wage, which will be added to his debit account.

In the first few years semi-annual crops may contribute considerably to the proceeds of the farm; bananas providing temporary shade for the young cocoa plants will also contribute to production during the first difficult years.

The farmer is charged interest at the rate of 4% of the capital invested. But for the first three years, when the farm is still being built up, payment of this interest is remitted. Furthermore, the farmer and his family enjoy free accommodation, and free food from the products of the farm.

Repayment of the invested capital takes place gradually, according to supple regulations which allow for the possibility of accelerated payment in times of good harvests and prices, and retarded payment in the case of bad harvests or low prices.

Any calculation of the financial return from these farms is, of course, speculative. In the first place, it is not possible to base all estimates of yield on actual production data and it is impossible to forecast the trend of the prices of the products.

According to a conservative estimate, the gross profit per hectare per year may be fl. 500, in which calculation neither the labour of the farmer and his family, nor income in kind (food) has been included. On this basis, it seems possible to pay off the debt in 15 to 18 years.

Research

From the very beginning agricultural research occupied an important part of the development programme of the project. The investigations included several crops and cultivation techniques on the different soil types and under different drainage conditions in the area.

With annual crops the growing and planting season, cultivation techniques, weed control and the influence of fertilising and manuring were particularly investigated. On the better soils pulses, such as soya beans, groundnuts and blackeye peas, thrived, sweet potatoes produced reasonable yields and water melons gave excellent results.

Generally speaking, the semi-perennial crops did better than the annual crops. Experiments on plant arrangement, fertilising and varieties produced valuable information. Bananas, pineapples, cassava and fodder grasses proved to produce good to very good yields if reasonably treated. Experiments for the most suitable rotation scheme were also included in the investigation programme of the annual and semi-perennial crops. In a number of plots kudzu and grasses will be included as regenerating crops in the rotation scheme.

For the perennial crops, experiments were carried out with various stocks for citrus, with shade elements for cocoa, and with various green manures. On the eight important soil series of Lelydorp experimental plots of about 25 trees of each perennial crop are demarcated, in order to follow the development and the production of the trees in the different classes of soil fertility.

As regards cattle, the increase in weight in zebu calves and Creole cattle is being investigated and very good

Young oil palm with kudzu cover and plantain catch-crop. One year after land-clearing and nine months after planting of oil palm

House and garden of a 5-hectare farm

results are recorded. Determinations of crude fodder consumption, milk yield, fat content of milk and manure production take place regularly. Endeavours are made to obtain progeny with better milk yield and adequate resistance to tropical conditions by artificial insemination of zebu and Creole cows with semen from Friesian bulls. The question of storing farmyard manure has also been taken in hand.

The range of pasture grasses requires improvement. For this purpose, six pasture grasses are now being compared on several types of soil and propagation fields have already been laid down. Rotation of pastures and better care of grassland are put forward.

The Lelydorp project in its setting

Although it will not be possible to give a more definite verdict on profits from the scheme until some years have passed, present experiences justify the expectation that, provided the farms are well managed, the financial returns will be satisfactory.

The conclusion can be drawn that the types of farm projected in the Lelydorp settlement are *at present* beyond the power of the mass of the rural population of Surinam to manage. For the same reason it is certain that the project cannot yet make a contribution towards relieving the towns of their surplus population, as was originally one of its aims.

In addition, it will be possible to start reforming already existing and badly managed agricultural settlements in the Old Coastal Plain, according to the principles of the Lelydorp Project. The opportunity for doing this is apparently present in the area immediately surrounding the project.

In the opinion of the authors, it will be possible for the project to become a centre for rural development in the broadest sense of the word. Real understanding on the part of the farming population is a *sine qua non* for a radical reform of the situation. If this understanding is absent, any large-scale agricultural development scheme is bound to fail. Understanding and knowledge must be imparted by means of demonstration and education. The Lelydorp Project, as an example of good management, offers in this respect a very sound starting point. On the basis of the project the extension service can, little by little, systematically raise the level of agriculture in this district. The Lelydorp Project can, at the same time, lay the foundations for long-term scientific research in the Agricultural Experimental Station.

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New Appointments

Whitlock Bros. Ltd., Great Yeldham, Essex, the well-known agricultural and industrial equipment manufacturers, announce that Mr. Gordon A. Hick will join their staff as Sales Director with effect as from April 4, 1955. Mr. Hick is already well known in agricultural and industrial circles, having held the appointment of Home Sales Manager with Messrs. J. W. and T. Conolly Ltd. for a number of years.

Dr. E. Holmes and Mr. F. Taylor have been made directors of Plant Protection Ltd. Dr. Holmes will be technical and development director, and Mr. Taylor finance and overseas director. Dr. Holmes joined the company in 1937, and has been head of its technical department since 1940. He will work in close collaboration with Dr. Boon, of Jealott's Hill Research Station, who has also recently been appointed to the board of Plant Protection Ltd.

Mr. Taylor was appointed secretary and chief accountant of Plant Protection Ltd. in 1943. In 1951 he was appointed, in addition, chairman of Tomlinson and Hayward Ltd., insecticide manufacturers. Since 1947 he has supervised the financial and general commercial interests of Plant Protection on the Continent.

Aerial Photography Requirements for Soil Survey Field Operations

C. L. W. SWANSON

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This paper presents the major results of a study of technical requirements for aerial photography suitable for soil-survey field operations which was made by the National Soil and Fertiliser Research Committee, U.S.A. The study was based on a questionnaire circulated to organisations concerned with soil surveys in all States and territories of the United States. A partial summary of the questionnaire returns is given.

AERIAL photographs have been widely used in the mapping of soils for 20 years.* This experience has indicated important differences in the usefulness of available photography. Consequently, in 1952 a work group of the National Soil and Fertiliser Research Committee† made a study of technical requirements for aerial photographs to be of maximum usefulness in soil-survey field operations. A questionnaire was prepared and circulated to organisations concerned with soil surveys in all States and territories of the United States. Organisations in 31 States and in Alaska replied to the inquiry, with responses ranging from a low of 40% in the Great Plains to a high of 88% in the Corn Belt (groupings of States are given in Table 1). A summary of these responses has been prepared and made available to governmental organisations concerned with soil surveys and with aerial photography. Major points of the summary are presented here with the thought that they may be of interest to a larger audience.

The replies generally indicate that standard government specifications for aerial photography at a scale of approximately 1 : 20,000 are satisfactory for soil mapping. For some purposes, larger scales are desirable and for others smaller scales would be better, but such needs are a minor part of the total. The timing of photography by seasons could be improved in a number of instances, however, with the result of photographs being more useful for soil-survey field work. Although time preferences differ from one region to another, they largely coincide with the period of the year when soil cover is at a minimum. In other words, the aerial photographs which show the surface of the soil itself as clearly as possible are of greatest usefulness. Thus, the preferences identify the time of year when

TABLE 1
GROUPS OF STATES

North Eastern	*Corn Belt*	*Southern*	*Great Plains*	*Far Western*
Maine	Missouri	Virginia	North Dakota	Washington
New Hampshire	Minnesota	North Carolina	South Dakota	Oregon
Vermont	Iowa	South Carolina	Montana	California
Massachusetts	Wisconsin	Florida	Wyoming	Idaho
Connecticut	Illinois	Georgia	Nebraska	Nevada
Rhode Island	Michigan	Mississippi	Colorado	Arizona
New York	Indiana	Arkansas	Kansas	Utah
New Jersey	Ohio	Louisiana	Oklahoma	
Pennsylvania		Alabama	Texas	
Delaware		Kentucky		
West Virginia		Tennessee		
Maryland				

TABLE 2
QUESTIONNAIRE ON AERIAL PHOTOGRAPHIC REQUIREMENTS FOR SOIL SURVEY PURPOSES

1. What time of year is best suited to taking aerial photographs to obtain best detail of soil conditions in aerial photos for use in soil survey work?
   (*a*) Jan., Feb., March. (*c*) July, Aug., Sept.
   (*b*) April, May, June. (*d*) Oct., Nov., Dec.
   (*e*) Other.
2. (*a*) In predominantly cultivated areas, do you prefer having maximum vegetation on the ground cover? (*b*) Intermediate vegetation? (*c*) Minimum vegetation? (*d*) Other?
3. (*a*) In predominantly forested areas, do you prefer maximum vegetation on the ground cover (leaves and all foliage in full growth)? (*b*) Intermediate vegetation (leaves and foliage in initial stages of spring growth)? (*c*) Minimum vegetation? (*d*) Other?
4. (*a*) Do you prefer having the photographs taken with maximum soil moisture? (*b*) Intermediate? (*c*) Dry soils? (*d*) Other?
5. (*a*) Do you prefer having the photographs taken with 1 ft. or more of snow cover? (*b*) Less than 1 ft. of snow cover? (*c*) No snow cover?
6. Photographs taken during early morning and late afternoon sometimes result in photographs with a long shadow effect. (*a*) Do you prefer photographs taken during early morning? (*b*) Middle of day? (*c*) Late afternoon?
7. Do you have any preference as to type of photography?
   (*a*) High oblique. (*c*) Continuous strip vertical.
   (*b*) Low oblique. (*d*) Multiple-lens vertical.
   (*e*) Single-lens vertical.
8. Do you have any preference as to direction of flight?
   (*a*) North and south. (*b*) East and west.
   (*c*) Other.

*Rourke, J. D., and Austin, M. E., 1951: 'The Use of Air-Photos for Soil Classification and Mapping in the Field,' *Photogrammetric Engineering*, 17, 738-747.

†The National Soil and Fertiliser Research Committee was established by memoranda of understanding between the U.S. Department of Agriculture and the Land Grant Colleges to provide for co-ordination in soil and fertiliser research in the United States.

TABLE 3
PARTIAL SUMMARY OF QUESTIONNAIRE RETURNS BY REGIONS
(The number for each question is indicated by an Arabic numeral and subdivisions by small letters)

	1a	b	c	d	e	2a	b	c	d	3a	b	c	d	4a	b	c	d
North-Eastern States ..	15.3	46.2	7.7	23.1	7.7	—	11.1	88.9	—	12.5	37.5	50.0	—	22.2	77.8	—	—
Southern States	58.3	16.7	—	16.7	8.3	14.3	14.3	71.4	—	—	28.6	71.4	—	—	100.0	—	—
Corn Belt States	20.0	60.0	10.0	10.0	—	—	14.3	85.7	—	—	14.3	85.7	—	—	100.0	—	—
Great Plains States ..	—	42.9	28.5	14.3	14.3	—	50.0	50.0	—	—	25.0	75.0	—	—	100.0	—	—
Far Western States ..	—	20.0	40.0	20.0	20.0	—	25.0	75.0	—	25.0	—	75.0	—	—	40.0	60.0	—
Alaska	—	100.0	—	—	—	—	—	100.0	—	—	—	100.0	—	—	100.0	—	—
Total	22.9	39.6	12.5	16.7	8.3	3.1	18.8	78.1	—	6.5	22.6	70.9	—	6.5	83.8	9.7	—

	5a	b	c	6a	b	c	7a	b	c	d	e	8a	b	c
North-Eastern States ..	—	—	100.0	—	100.0	—	—	—	33.3	—	66.7	100.0	—	—
Southern States	—	—	100.0	12.5	87.5	—	—	—	16.7	—	83.3	100.0	—	—
Corn Belt States	—	—	100.0	—	100.0	—	—	—	16.7	—	83.3	100.0	—	—
Great Plains States ..	—	—	100.0	—	100.0	—	—	—	25.0	50.0	25.0	50.0	25.0	25.0
Far Western States ..	—	—	100.0	20.0	60.0	20.0	—	—	—	—	100.0	100.0	—	—
Alaska	—	—	100.0	—	100.0	—	—	—	—	—	100.0	100.0	—	—
Total	—	—	100.0	5.9	91.2	2.9	—	—	19.2	7.7	73.1	92 0	4.0	4.0

vegetative cover is at a minimum and the ground is free from snow. By and large, more States preferred the second quarter of the year (April, May and June) than any other.

Regional preferences in the timing of aerial photography are related to the proportions of land in crops, forest or grass and to the duration of snow cover. Where the land is predominantly in cultivation, photographs taken during the period of minimum vegetation are strongly favoured. This coincides with the spring period in the Corn Belt States, in the North-eastern States, and in the northern part of the Great Plains. It coincides with the winter season, or first quarter of the year (January, February and March) in the Southern States. In predominantly forested regions, there is a general preference for photographs made when trees are bare or have leaves in the first stages of spring growth. In regions where most of the land is in grass, as in parts of the Great Plains, preferences for any season are slight except where snow cover must be avoided. Some preference does exist for the spring when vegetative cover is at a minimum.

General preference was shown for single-lens vertical photographs taken in a north-south flight line. Similarly, nearly all replies favoured photographs taken during the middle of the day when shadow effects were smallest. Most replies also favoured photographs taken when the soils were at intermediate moisture contents. Experience with photographs made at different but known conditions of soil moisture is too limited to provide a basis for full judgment on this point.

The questionnaire also made inquiries about the comparative usefulness of mosaics and individual photographs, contact prints versus enlargements, the best type of paper for prints, and the like. The replies to these questions were summarised in the report of the work group, but being of little general interest they are not considered here.

To provide interested readers with more complete information, a partial list of the questions asked organisations concerned with soil surveys is given in Table 2. An analysis of the replies to those questions by regions is given in Table 3. Already summarised to some extent, the data in Table 3 give a more detailed picture of time preferences by regions that can be indicated conveniently in text. Study of the data will show that a marked preference exists for aerial photographs made during periods of year when vegetative cover is at a minimum and the ground is free of snow.

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Farm Machinery Merger

Through a newly formed holding company in Australia all the outstanding shares of H. V. McKay-Massey-Harris Pty. Ltd., Sunshine, have been purchased by Massey - Harris - Ferguson Ltd.

These long-established companies have been closely associated during the past 25 years and both have contributed greatly to the modern mechanisation of Australia's farming.

Mr. J. S. Duncan, chairman and president of Massey-Harris-Ferguson Ltd., will become chairman of the board of H. V. McKay-Massey-Harris Pty. Ltd. and Mr. L. T. Ritchie, a vice-president of the Canadian company, is appointed managing director.

The association of the original Massey Co. of Canada with Australian agriculture also dates back to 1884, when Toronto-built binders were first imported. In 1887, Walter Massey went to the Commonwealth to set up agencies and during the next 20 years representatives of the company, Canadian and Australian, developed the stripper, or header, and the reaper-thresher, from which were to evolve the Massey-Harris combines.

When, in 1930, tariff legislation virtually stopped imports of Canadian farm implements into Australia the holdings of the Massey-Harris Co., as it had by then become, were amalgamated with those of H. V. McKay Pty. Ltd., who were making the famous ' Sunshine ' line of implements. Although substantial shareholders in the new company of H. V. McKay-Massey-Harris Pty., the Massey-Harris Co. still retained, however, its own identity in Australia until this latest merger. The Australian amalgamation adds the big Sunshine Works in Melbourne to the manufacturing resources of the company. These are only slightly less in area than its largest factory in Toronto.

Site of the Kawerau paper mill being established by the Tasman Pulp and Paper Co.

Exports Vital to New Zealand's Forest Industries

RONALD E. MURRAY

WITH the deadline for manufacture of newsprint in New Zealand less than six months away, mill construction and acquisition of plant is being pushed ahead with all speed. During this year outlay on the Tasman Pulp and Paper Company's project will be at its highest level.

Interest in the commercial use of New Zealand's pine forests has been greatly increased by current developments.

New Zealand's forests are the raw material for new industries which seem destined to fill a very important place in the Dominion's economy.

Geographical distribution of forests is stated to be important in relation to costs. Except for small areas in the Wellington, Hawke's Bay and Taranaki districts, the North Island is dependent on supplies from the Rotorua district, with associated heavy freight costs. The Forest Service is now planning increased plantings in other parts to reduce dependence on the Rotorua supply.

A problem for exotic sawmillers is the disposal of the lower grade Radiata pine timber which comprises 40% of the cut. Increasing use of fibre cartons and multi-wall bags is making it difficult to dispose of all this timber as wooden boxes, and users wanting it for concrete boxing and 'sarking' prefer the wider sizes only.

New Zealand's forests play a vital part in the country's economy. This article describes the output from New Zealand paper mills and, in particular, the planning of the paper mill site at Kawerau. This project will be producing this year and is expected to save the British Commonwealth an expenditure of $16,000,000 a year.

Integrated milling

The suitability of pine for pulp and paper has firmly established the advantages of integrated sawmilling with pulp and paper manufacture, so that the 50% wastage that normally goes in sawdust and slabs in sawmilling can be profitably adsorbed in the pulp mill.

Although, in 1940, Whakatane Board Mills Ltd. established a mill to produce cardboard, and shortly afterwards New Zealand Forest Products Ltd. began to manufacture wallboard, the full advantages of integration were not achieved until the opening in the latter part of last year of the combined sawmill, pulp mill and kraft-paper mill at Kinleith. The same principle of integration is being adopted in the sawmill, pulp mill and newsprint mill now being built at Kawerau by the Tasman Pulp and Paper Co.

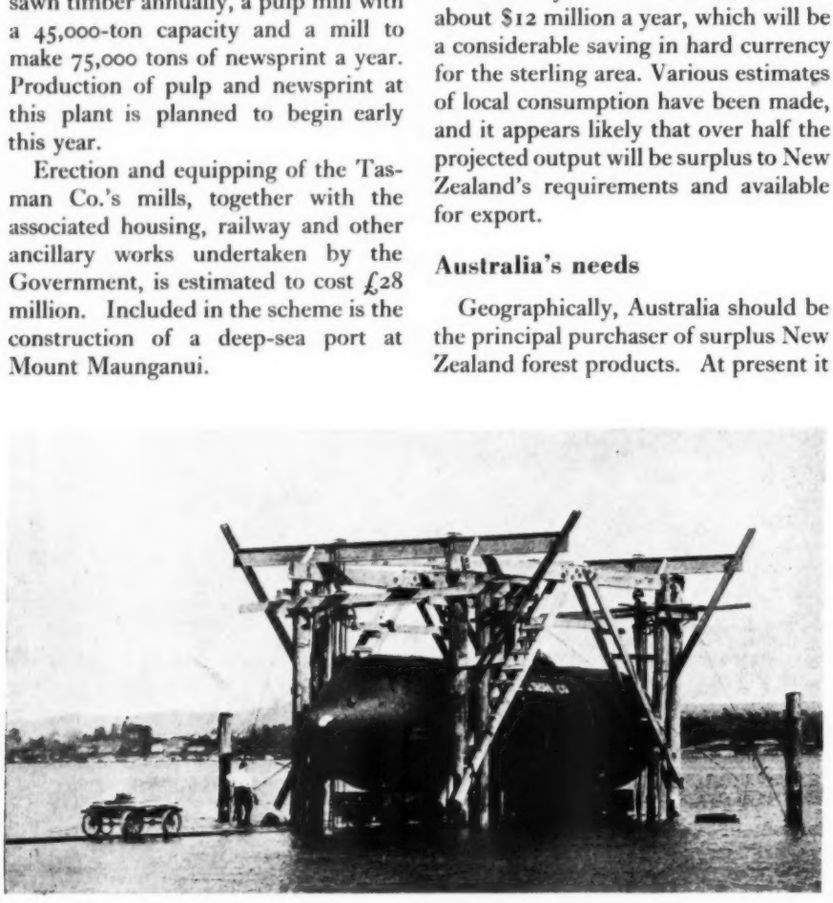
Forest Products Ltd. owns and controls 176,000 acres of forest and has established a sawmill capable of producing sawn timber at the rate of 42 million board feet annually. The kraft mill, using offcuts from the sawmill, which alone will yield 10,000 tons of pulp annually, has a capacity of 45,000 tons of unbleached kraft a year. To complete the project, a paper mill with an annual capacity of 25,000 tons has been built to manufacture heavy packaging and wrapping paper and liner-board.

The organisation's activities are further integrated, as part of the output from the paper mill will go to its paper-bag factory to be made into multi-wall bags. In addition, 20,000 tons of wallboard are being turned out yearly at the company's Penrose mill.

Newsprint this year

The Tasman Pulp and Paper Co. was the successful tenderer for the log supply from the Kaingaroa State Forest and is building a sawmill capable of producing 72 million board feet of sawn timber annually, a pulp mill with a 45,000-ton capacity and a mill to make 75,000 tons of newsprint a year. Production of pulp and newsprint at this plant is planned to begin early this year.

Erection and equipping of the Tasman Co.'s mills, together with the associated housing, railway and other ancillary works undertaken by the Government, is estimated to cost £28 million. Included in the scheme is the construction of a deep-sea port at Mount Maunganui.



Unloading and landing one of the 40 digester tanks

Production of cardboard by Whakatane Board Mills Ltd. is at present 15,000 tons per annum, and plans are in hand to double this quantity. It is expected that the new plant will be in operation by July 1955.

With the completion of all these projects the production potential from the exotic forests in 1956 should be:

Sawn timber, 350 million board feet; cardboard, 30,000 tons; wallboard, 20,000 tons; kraft pulp, 90,000 tons; kraft paper, 25,000 tons; newsprint, 75,000 tons.

This capacity will provide a considerable quantity for export after meeting all local needs.

Marketing of paper and pulp products may present some difficulties when the planned capacity becomes available in 1956. The primary outlet will be, of course, the local market, which at present imports newsprint, pulp and pulp products to the value of £NZ8 million per annum, mainly from the dollar area. The establishment of this industry in New Zealand will save about $12 million a year, which will be a considerable saving in hard currency for the sterling area. Various estimates of local consumption have been made, and it appears likely that over half the projected output will be surplus to New Zealand's requirements and available for export.

Australia's needs

Geographically, Australia should be the principal purchaser of surplus New Zealand forest products. At present it is a substantial importer of newsprint and, to a lesser extent, pulp and paper products, mainly from Scandinavia and the dollar area. Pulp from Australian hardwood is of short fibre and long-fibre pulp must be imported for blending.

Newsprint demands in Australia are now at least 120,000 tons a year in excess of Australian production. Thus with a strong market for the newsprint in Australia the disposal of New Zealand's surplus should be assured.

Chemical pulp, however, will face a stronger competitive market. Australia at present produces the bulk of its requirements of kraft paper and pulp products and has plans for further expansion. Before the establishment of the Kinleith mill, N.Z. Forest Products Ltd. arranged a long-term contract to supply the Australian Newsprint Mills at Boyer, Tasmania, with 12,000 - 14,000 tons of long-fibre kraft pulp per annum, and the first shipment under this contract was shipped from the Dominion in August 1954.

Additional markets for long-fibre pulp exist in Australia and it has been estimated that by 1956 Australia will want to import more than 50,000 tons of this product. Large potential demand also exists in Asia, particularly as the standard of living rises and education of the masses proceeds. This seems the logical place to establish new markets.

Over-emphasis of the importance of these new forest industries would be difficult, but prudence dictates that future developments should be firmly based on New Zealand's domestic requirements. On this sound basis output could be expanded to supply new oversea markets as they are developed and the industry placed in a position to take profitable advantage of conditions abroad. There is little doubt that the forest industry will become increasingly important to New Zealand, helping to provide a most desirable balance in what has been predominantly a rural economy.

Paper-mill site transformed by year's work

Just over two years ago the first farm gate was opened at Kawerau, New Zealand, to allow the passage of the first equipment for the enormous mill- and town-construction programme of the Tasman Pulp and Paper Company. Since that day the transformation of a quiet rural landscape rich in Maori legend has progressively grown in tempo.

The first year has been largely characterised by the unspectacular yet essential spadework involved in planning, surveying and assessing costs, linked with the mustering and organising of the building force—men, materials and machines.

Apart from deciding upon the town site and the setbacks caused by a wet winter, the project has got under way with remarkable speed. As this pace increases during the ensuing year an unapproachable building record for New Zealand will be created and railway installations are now being built on

the Maori land to the east of the Tarawera river, while the town is rising on land formerly farmed by the Lands and Survey Department on the opposite bank.

Also within the past two years the town has been formally named Kawerau, which has become accepted and widely known. Initially the area was known as Onepu, a name borrowed from the thermal springs on the far side of the river. The name Kawerau was derived from the name of an old Polynesian chief, Tini-O-Kawerau.

The overall impression of the first year's progress is one of marshalling and dovetailing resources, and laying foundations for the peak construction effort this year. Efficient organisation seems to have crushed old problems and the pumice plains of Kawerau are ready for an intensive building drive.

Californian link with New Zealand's paper mills

Under the banner headline ' Gold Dust to Newsprint Down Under,' an American quarterly engineering magazine, ' The Black Horse News', describes the Tasman Pulp and Paper Company's Murupara project in New Zealand.

The article begins: ' California prospectors seeking gold in the " Down Under " countries are believed to have unknowingly planted the seeds for a major new industry now taking shape in New Zealand. History says it was they who first brought the Monterey pine (*Pinus radiata*) to that far side of the world.

' That was a century ago and today Monterey pine blankets more than half the huge State-owned man-made Kaingaroa forest that is to supply timber for the mills of New Zealand's first newsprint industry.

' Behind the Murupara project is a long story of planning and preparation for the day when New Zealand could exploit its lush, quick-growing pine forests, insure itself an adequate newsprint supply and win a share of the lucrative, expanding newsprint market abroad. No log was left unturned to guarantee the feasibility of the project.

' Officials report that pines grow more than twice as fast as in our Southern States and several times faster than in Canada or Scandinavian countries.'

Loan for Murupara

The Export-Import Bank (Washington) has approved a loan of $16 million (£5,700,000) to the New Zealand Government to finance the dollar costs of the Murupara project. This includes the costs of ancillary works such as the railway and harbour development at Tauranga.

The loan will bear interest at 4¾% and will be repayable in half-yearly instalments over 10 years, beginning November 1956.

This means that repayments will begin about 12 months after the Murupara mills are in production, thereby making dollar savings much in excess of the repayment instalments of the loan.

The Tasman Pulp and Paper Company planned to produce up to 72 million board feet of timber per annum, about 36,000 tons of chemical pulp in excess of needs for production of paper and about 75,000 tons of newsprint.

The spokesman said about one-third of the loan would provide the dollar exchange with which the company would obtain materials, equipment and services in the U.S.A. for use in mills now under construction.

Procurement of equipment for erection of these mills was being undertaken by the Fletcher-Merritt-Raymond joint company formed by the Fletcher Construction Company of New Zealand and two United States contractors—Raymond Concrete Pile Company and Merritt-Chapman and Scott Overseas Incorporated.

With the remaining two-thirds of the loan the New Zealand Government would finance purchase in the U.S.A. of materials, equipment and service for various ancillary facilities which were being furnished by the Government as part of the Murupara project.

It was expected that funds for this loan would be obtained from private financing institutions in the U.S.A. under the bank's guarantee.

A £10-million loan to finance the sterling content of the Murupara project was taken up in London in December 1953.

Money will be spent in the United States, the United Kingdom, Canada, Australia, Sweden and Switzerland before the mills produce.

The project is expected to save the British Commonwealth an expenditure of about $16 million a year and latest estimates are that the mills will be producing this year.

British Standard for Returnable Boxes

B.S. 2568:1955 has been issued as part of the programme of standardisation of boxes and crates for horticultural produce.

In the course of preparing this standard, it was pointed out that there would be certain advantages in reducing the side boards of bushel boxes to 9 in. in width, so that the box maker could use 4½-in. boards for both sides and ends. To maintain the capacity, however, this would mean allowing a larger gap between the two boards or a gap on the bottom of the lower board, thus weakening the box. On inquiry it was found that neither of these proposals was acceptable to growers in general, and this construction is, therefore, not recommended in the standard. As, however, British Standards are not obligatory, there is no doubt that boxes of this construction will continue to be used. If they are found to gain in popularity, the position will be reconsidered when the standard is due for revision.

Farmers' Leaflets

The National Institute of Agricultural Botany have recently published three revised farmers' leaflets. These include leaflets on sugar beet and on fodder beet and mangolds. They follow the institute's usual practice and summarise the character of the strains in tabular form as well as giving a short paragraph of descriptions of each of the strains mentioned.

The revised potato leaflet represents a new development for the institute, for, for the first time, it includes a recommended list of potato varieties. The leaflet includes five first early varieties, four second early varieties and five maincrop varieties.

Copies of the leaflets may be obtained from the Secretary, N.I.A.B., Huntingdon Road, Cambridge.

Agriculture in the Soviet Union—I

W. G. CASS

This article presents an account of the great Moscow Exhibition (1954), followed by a report of the present standing of the Williams' theory of crop rotation in Russia today. There is a considerable amount of criticism of the deficiencies in agriculture and other branches of the Soviet industry, nevertheless marked progress has been made in the past few years.

OPINIONS differ as to the value of some of the new Russian ideas and methods in agriculture, including stock-breeding and genetics; indeed, the Soviet agronomists are by no means agreed among themselves on matters of agricultural policy and practice, and more or less vigorous polemic is by no means infrequent in Russian agricultural literature, as well as in the general press, *e.g.* in the columns of *Pravda*. But, on the whole, it must be admitted that marked progress has been made. It is only too likely that progress, after all, is better stimulated in an atmosphere of argument and criticism than in one of calm and complacent unanimity. And it is well to realise, too, that, despite some apparent exaggeration and boasted achievement, there is a considerable amount of pungent criticism and concentration on deficiencies (*nedostatki*) both in agriculture and in other branches of Soviet industry.

This is well illustrated in a recent article in *Pravda* by Acad. N. Tsitsin, Director of the All Union Agricultural Exhibition, 1954. Many of the foreign visitors and invited delegations from all parts of the world were impressed by the magnificence of this unique display—probably the largest of its kind in the world—in the beautiful and spacious grounds and parklands of the Ostankino Palace. It afforded real and tangible evidence of remarkable achievement in many directions, notably in that of mechanisation. Yet the Director, in the article mentioned above, has much to say on wrong methods, unscientific ideas, etc., in various sections of Soviet agriculture.

Among the first of a rather bewildering and rapid sequence of impressions would probably be that of spaciousness; the whole of the 500 acres or more was fully occupied without overcrowding and the idea of vastness would be intensified by the powerful aid lent by the genius of Russian architecture, especially in the huge main pavilion with its three tiers of buildings rising to more than 300 ft. Many of the other 75 pavilions showed similar architectural taste and skill, enhanced by large lawns, flower beds in brilliant colours and natural woodland. Art and nature combined to give a pleasing effect. For example, the pavilion devoted to fur-bearing animals had in its vicinity some realistic wild country of wood and glen where the animals could be seen in their nearly natural habitat. Architecture, too, played a leading role in that part of the exhibition devoted to rural housing and farm buildings, to which much attention and study are now being devoted both by architects and the directors of State and collective farms.

Ploughing up virgin soil at the Khankai Rice State Farm

The main pavilion

One of the basic considerations in planning the main pavilion, and, in fact, the whole show, was educational—to give the Soviet people some idea of what had been accomplished in raising the standard of rural life and the efficiency of Russian farming. It sought a glimpse into the hopes and ambitions of future planning, with its millions of new acres reclaimed by irrigation or other methods, its new and improved varieties of plants, and the wonders of the present and future progress of mechanisation. All these and much else were impressively presented, not only in a wonderful series of scenes from real life and work, with machinery going full speed—ploughing, sowing, harvesting, processing etc.—but also by use of the visual arts to a high degree, pictures, models, dioramas, huge maps (profiled) and much else.

Irrigation was realistically shown in actual operation and attracted much interest. Mechanisation in various forms was exemplified, among other ways, in a huge composite group, much of it in actual operation, and occupying a space of 318,000 cu. m. in 26 different departments. During the period 1954-57 it is confidently expected that the number of tractors available will be 500,000 or more for general purposes, in addition to another 250,000 machines for special work.

The superiority of the State and collective farms (Kolkhozi) over the individual was, of course, strongly emphasised, although a considerable amount of opposition to these still persists among some sections of the peasantry. The directors of some of the collective farms are from time to time charged with neglect and inefficiency and consequent *nedostatki*. Many examples of collective farm working were shown, among which was the Buzhonni kolkhoz, in the Omsk district, where yields per hectare are said to have increased from a few double-centners (dc.) to 23.5 dc. (10 bushels per acre) in 1952-53. The size of this farm is 3,430 ha. (about 8,200 acres).

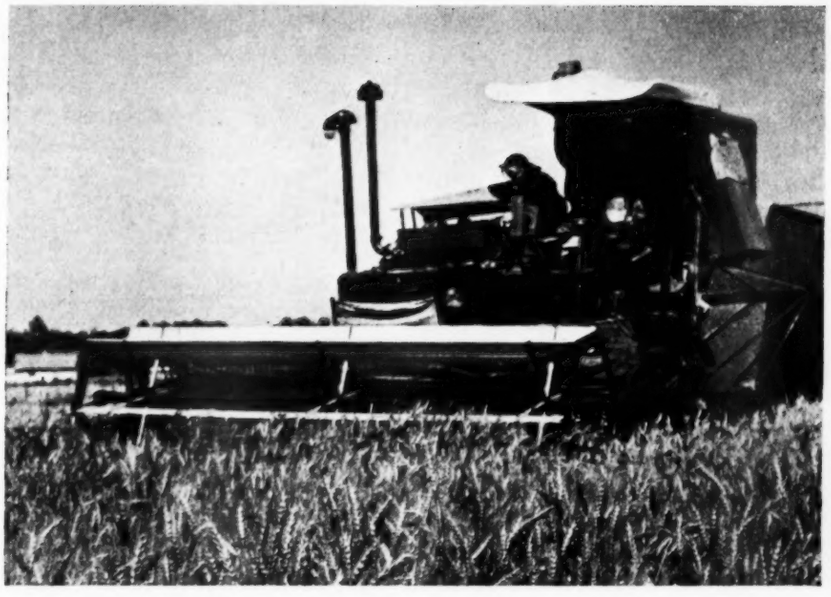
Russian plants

Another very interesting feature of the exhibition was that in which the rich variety of Russian flora was beautifully exemplified on a large scale, with special reference to the cultivated species and the work of Mitshurin and his school, whereby the number of economic plants has been greatly increased. Some 300 new varieties of fruits and berries were shown, some under actual cultivation in a large fruit plantation.

Thanks to irrigation on a large scale and other forms of land reclamation, enormous areas of new lands have become available. For example, in Kazakhstan (Caucasia) the so-called Hunger Steppes have been converted into flourishing cotton fields, of which some show plots were included in the exhibition. Elsewhere in the same republic tea plantations have been extended, *e.g.* on the so-called Tea Mountains where yields of 15 tons of green leaves per ha. are recorded.

Six pavilions were devoted to emphasising the progress made in various directions, such as seed selection and improvement (plant genetics generally), soil mechanics and structure, new forms of soil cultivation—referred to below in the section on general Soviet agriculture—such as deep ploughing without mould-boards (presumably subsoil ploughing) once in three or four years, with surface scraping in between, *i.e.* sowing on the stubbles, etc. Primary attention, of course, is given to cereals. Yields throughout the Soviet Union are said to have grown fourfold since 1926. Wheat cultivation now forms 45.3% of the total, compared with 36.4% in 1940. Numerous other crops for fibres, for oils and fats, for ethereal oils, etc., were also seen, either in actual cultivations, or by visual aids, or both. In all cases individual workers who have established records for good work and high skill were prominently publicised. This is, of course, an important feature in Russian incentive policy.

It is not possible here to say much more about the exhibition, and one must pass now to some general notes on the vast and varied subject of Soviet agriculture. It may be permitted, however, to quote the words of the exhibition director in a notice prominently displayed in the main hall:



Self-propelled combine harvesting wheat at the Molotov Collective Farm

> 'Consider well the figures and results shown here, and study the means by which they have been obtained. But do not regard these merely as a prescription, as a universal remedy, a narrow dogma or immutable doctrine. Only on the basis of your own work and efforts and continued research is it possible to find the correct methods for every individual case.'

Grain output

Average output of grain throughout the Soviet Union for the five-year period 1949-53 was 124 million tons per annum, compared with 78 million tons in 1909-13 and, allowing for exports, the retained average of grain per head of the population rose from 8.4 cwt. per annum to 12.1 cwt. Still larger outputs, nevertheless, are required on several grounds: (*a*) to satisfy the growing needs of the whole population, including bread made from best quality flour, (*b*) supplement State reserves, (*c*) ensure sufficient grain fodder for livestock, (*d*) increase surplus available for non-grain districts—industrial or those growing non-cereal crops, (*e*) expanding grain exports. According to the report of the Central Statistical Department published at the end of July 1954, the spring sowing plan, including new areas, was more than fulfilled. Of the 32 million acres scheduled for ploughing in 1954-55, the State and collective farms had already completed 25 million acres by July 10. By the middle of August the total area ploughed for the Russian Federation and Kazakhstan was 35 million acres.

Williams' theory

Particular attention has been given in recent years to the grasslands system or perennial grass rotation developed by Vassili R. Williams, of which one special feature claimed by its adherents is that perennial grasses enrich the soil with organic material and 'give it structure,' whereas annuals do not. But this is disputed by many authorities, including T. S. Maltsev, who is referred to below. Another disputed question concerned the indiscriminate application of the Williams' teaching irrespective of local conditions of soil, etc. Even the State Planning Commission and the Ministries of Agriculture and State Farms have been censured by the Central Committee of the Soviet Union Communist Party (in their directives) for mischievous and wrong application, *e.g.* in the sowing of low-yield perennial grasses in the dry and semi-dry areas of the southern Ukraine, Moldavia, northern Caucasus and elsewhere, with a corresponding decline in areas sown to much more useful crops, namely maize, legumes and fodder crops.

Another mistake alleged against the

Williams school is their underestimate of the value of winter wheat in areas where the yield is much higher than with vernalised wheat. The latter undoubtedly is better adapted for most of Siberia and the Volga district, where it gives a high yield. But in the Ukrainian steppes and other areas the sowing of vernalised wheat after perennial grass gave poor yields, and winter wheat results have been proved much better.

The obvious corollary is better adaptation to local conditions — if such a phrase can be used for some of the vast districts of the Soviet Union. Yet another error of this school was underestimation of the value of fertiliser, both organic (lupin and other crops) and inorganic, and too much dependence on a rotational system (*travopolye*) in which perennial grasses played a leading role.

The soil analyses and other studies in soil science now proceeding throughout the Union are providing valuable information and reveal the urgent and serious need of judicious use of fertiliser on a large scale, including liming. More attention must be given to the value of clover in many areas. Thousands of acres have been ploughed up, to the serious detriment of soil economy.

The criticism of the Williams' grassland policy (*travopolye*) is not so much against that policy itself, but against its indiscriminate application in localities or under conditions where it is inapplicable. N. Tsitsin says (in *Pravda*): ' We have respected and will continue to respect both Williams and his work. One cannot forget, for example, that clover, in a humid non-black earth zone, provides a high yield of hay and is the best preceding crop for flax.'

Tsitsin also remarks that some Soviet scientists, quite contrary to practical experience, persist in holding that winter wheat is an uncertain crop. For example, the Lysenko All-Union Selection and Genetics Institute has for some time expressed the view that it was sound policy to increase vernalised wheat acreage and reduce that of winter wheat in the southern districts, especially in the Ukraine. This is said to contradict practical experience in those areas and is definitely contrary to the best interests of the national economy.

Research

Despite conflicting views and severe criticism of one school by another, agricultural research may be said to be progressive in the Soviet Union. The controversial matters, after all, only constitute a relatively small part of the field. Clearly the greater mass of research results is incontrovertible and has world-wide acceptance, including Russia. It is in the application of these results without due regard to ambient conditions that serious mistakes could be made. But this does not invalidate the results. (It is not possible to discuss here the philosophical question of whether all science and its results are in a state of flux and only relatively permanent.)

At conferences in Russia towards the end of 1953 and in the spring of 1954, and also subsequently, a great variety of subjects connected with agriculture and the soil have been discussed. Of particular interest was one held in August 1954 on the collective farm known as ' Lenin's Behest ' (Shadrinck district, Kurgan), where the director of the farm and experimental station, T. S. Maltsev, has tried a new system of soil cultivation during the past few years and has now reported results.

Harvesting wheat on the Molotov Collective Farm, Kirghiz S.S.R.

He disagrees with the view that perennial grasses, decaying mainly under non-aerobic conditions, improve the soil, whereas annuals under aerobic conditions leave little or no enrichment or compost. He considers that, under the right conditions and with appropriate rotations, annuals can be as effective in improving the soil as the perennials, especially under his new system of unploughed soil, where the limited amount of air creates largely non-aerobic conditions. He thinks that all plants, perennial or annual, leave in the soil more organic material than is used in feeding the plant. The different levels of root systems—down to a metre or more—in the soil are a major factor in soil nourishment.

About 1943 a system of deep ploughing (40-50 cm. or more) without mould-boards was begun on Maltsev's collective farm. This may therefore be regarded as a form of subsoil ploughing and was done about once in four years. The method was further developed subsequently, with the establishment on the farm of an experimental station in 1950, and was partly stimulated by the fact that, in the trans-Ural areas (Kurgan is just over the Siberian border, 300 miles west of Omsk), the perennial grass system of Williams (*travopolye*) had not fulfilled the hopes at first anticipated. In the years between deep ploughings, grain and other crops are sown without ploughing (*i.e.* to any considerable depth).

During the past five years they have been sowing wheat, oats, barley, mustard, annual grasses, silage and other crops in unploughed stubble. Wheat yields have ranged from 12 to 40 centners per ha.—or 18 to 60 bushels per acre—but some seasons were relatively dry. A good harvest was expected for 1954, especially where there had been no ploughing for three years.

Short-crop rotation

Two types of short-crop rotation without perennial grasses were introduced: one four-course and the other five. The former comprised: (1) fallow, (2) vernalised wheat, (3) annual grasses for hay and seed or, alternatively, grain or inter-tilled crops, (4) wheat. The five-course rotation was: (1) fallow, (2) wheat, (3) oats, (4) annual grasses or legumes, etc., (5) vernalised wheat. The full text of Maltsev's report was published in *Pravda*, 8 August, 1954. The plough used, without mould-boards, was on view in one of the exhibition pavilions.

The Evolution of Tillage Implements — I

NORMAN L. GOODLAND

Tillage and preparation of soil for agricultural purposes is a very ancient craft. The author, in Part I of this paper, has traced the evolution of the art and implements used from the Neolithic age until the 19th century. Steam engines played a major role in the 19th century and, even today, in some parts of England, steam provides the motive power for ploughing.

TILLAGE implements are used before and after sowing; thus some of the processes of cultivation after the drill are referred to in this account. The main concern of the account is, however, the mechanical preparation of the soil between ploughing and sowing. Sowing is a very ancient art, existing long before ploughing and reaching right back into prehistory. It has always involved many processes, varying according to the farmer's preferences, his means or his inventiveness. This was the case even in the Neolithic age immediately before the use of the first metals.

Tillage implements in Neolithic times

Neolithic farmers are believed to have come to this country about 2800 B.C. They left a considerable amount of visual evidence of their lives and culture and are regarded by anthropologists as the first of the 'modern' peoples. This is partly because of their culture, which included farming, principally the domestication of animals, and, only secondarily at this time, agriculture.

We know of their agricultural activities because their small, irregular plots ringed with stone still exist upon some of our lonely moors. In addition, we have found their storage pits where grain was first charred and then stored, and we have also found actual grains of a short-eared club wheat, emmer, and a small pelt. We know also that these people introduced weeds not indigenous to these islands, such as poppies, speedwells and spurges; indeed, we know that most of our arable weeds are not indigenous to the country and have been spread as a result of immigration and subsequent cultivation. We know this through a complicated study of the all but imperishable parts of pollen grains, but there is no space for a longer account.

We know that the people themselves were small, dark men with the long skull common to the times, with aquiline noses, oval faces and a stature of about 5½ ft. These physical traits, together with some of the agricultural methods used, are seen in part among the population of the British Isles to this day. In passing, it is interesting to surmise that the women did the cultivating while the men were herding, hunting or warring. There is much evidence in our mythology and the story of our social evolution to show that women farmers originated the early religious concept of the soil in a female sense; 'Mother Earth' is a term universally used with hardly a thought as to how it arose.

The flint tools of Neolithic man continue to be found in abundance. Some have been classified by a careful study of their wearing and the marks showing how they were fitted with handles. It is certain that some were used as picks and hoes. Very definite is the use of some wooden survivals, a kind of digging-stick with a fire-hardened point. A modification of this is, perhaps, the earliest hoe, a stick with a branch on it at right-angles, the branch pointed and hardened by fire.

Bone was certainly used in connection with agriculture, as is shown by the still surviving examples from Neolithic flint mines, of antlers used as picks, and the blade-bones of cattle used as shovels.

Thus the whole process of soil preparation for sowing in Neolithic times was done mainly by the earliest forms of hoe. There is the possibility that a kind of plough was used by means of a flint share upon a beam, this guided by one person and drawn by another, since flints, which could have been used for such work, and which show signs of having been used for ground work, have been found. But it is doubtful whether, if this plough was used, the woman was always the draught unit, because early primitive social structure does not give evidence that the woman was in such a subservient position as she evidently was in later times.

The Bronze Age and Celtic-type peoples

Evidence of early Bronze Age cultivating implements, apart from the well-known light plough brought over by the Celts, is not very clear. Probably this has something to do with the fact that metal is perishable, and only in favourable circumstances does it survive in recognisable forms in the soil. It seems fairly safe to surmise, however, in view of bronze sickles and axes preserved in various collections, and in view of the fairly definite knowledge of the light Celtic plough, that the hand implements were bronze-tipped. Certainly it seems very likely that the light bronze-tipped plough was a development of the hoe, and some experts do not hesitate to state this as a fact. The date of this plough is about 750 B.C.

However, some 1,000 years later, we know that, besides a much later heavy plough existing among Celtic-type peoples of the West, the hoe only was used upon hilly country. Thus it is probable that the bronze or bronze-tipped hoe, or implements like it, were used to further break down the tilth

after ploughing had been done. The thorn harrow was also in use, probably soon after the Celtic light plough was invented, and certainly in Wales in A.D. 400. At this time, also, horse-drawn harrows were used; thus among Celtic-type peoples we begin to see a familiar pattern of soil tillage.

Romans

Even in agriculture the Romans did not depart from their principle of adapting their methods to those of the native peoples where possible. But they did grow grain for export on a vast scale in the North-East and East of England, and used a heavy wheeled plough known as the 'caruca', drawn by eight oxen. These were yoked four abreast, as were the oxen of the Welsh in A.D. 400. Their hand implements were wooden with iron working edges, and they used iron-headed implements in clod breaking. The pattern which Welsh farmers used in A.D. 400 gives us a clue to Roman methods of cultivation in this country. We do know that the haulage unit was the ox, a much smaller one than the heavy draught ox of medieval times, and that it was shod to protect it against heavy ground.

Saxons

The Saxon gebur, an unfree tenant of the thane or village overlord, probably included harrowing in his fixed services to his thane. Harrowing came under the multitudinous responsibilities of the Saxon bailiff-magistrate, or reeve.

The picture here of soil cultivation becomes much clearer. After the great Saxon eight-ox plough had dealt with its part of the preparation, the geburs and other unfree tenants were employed in smashing the clods with mattocks; and when the seed was sown, it was harrowed in. Hand implements were also used in this task, these being rakes and thorns, and doubtless the thorn harrow was used. The draught unit was oxen—a much more powerful kind than that used by the Romans, with a very long horn, and similar to the medieval draught ox. Spades, as in Roman and Celtic times, were wooden with metal cutting edges, the Saxon pattern having the handle inserted at the side, not the middle of the spade, leaving the top edge entirely free for pressure by the foot.

Normans

In Norman times cultivation changed only little. After two, three or four ploughings, gangs of men and women were employed in clod-smashing, using a variety of mallets and other tools for this purpose. There were harrows made of wooden frames through which iron tines were set. The draught ox was not in favour for this work, because of its slowness and uneven movement; in the Luttrell Psalter we see a picture of a harrow being drawn by a horse.

This harrow was a rectangular one made of heavy timbers, five top timbers athwart four bottom ones bearing stout iron teeth. There were four teeth to each bottom timber, these timbers running towards the line of draught, the teeth forward-pointing, one behind the other, in parallel rows across. The two outer lower timbers projected in front to carry an iron cross-bar upon which the draught was fixed. Although the Luttrell illustration shows this harrow going straight forward, the actual point of draught is at the left end of the iron bar, so it seems probable that the harrow travelled at an angle in order that all the teeth should give maximum service. In the illustration it is shown in use after sowing, but there is no reason to suppose that it was not also used before sowing if required.

Thorn harrows were also used, but obviously after sowing, and maybe upon pasturage; and we hear also of stone rollers. It is interesting to note that stone rollers continued to be used until recent times. The fine example of a stone roller (Fig. 1) is to be seen in the National Museum of English Rural Life at Reading.

16th and 17th centuries

No marked changes in the processes of tillage and cultivation occurred until well into the 18th century. Hand cultivating methods persisted and, in the 16th century, we hear of heavy ox harrows. These were much heavier than the horse harrows used for covering the seed and might well be regarded as the earliest of cultivators. On rough land, harrows with wooden teeth were used, since these could spring against the stones without breaking the teeth or, if the teeth were broken, they were easily replaced.

More care tended to be taken over tillage and cultivating in the 17th century and among the large variety of stone, wooden and iron-headed implements in use there were some of enormous proportions, like the mattock shown in Fig. 2; it is 3 ft. in length, and requires much effort to lift it from the ground, let alone wield it. Markham describes a harrow as a wooden framework with 10 tines in each side, drawn diagonally. Rollers, mostly of solid tree trunks and some of stone, continued to be used.

Thus 350 years ago the pattern took the following form. After several ploughings labourers were set to breaking the clods with hand implements. Where the land required it, rollers would be brought into use for further clod smashing, followed by heavy harrows. If the tilth was to be extra fine, as in the sowing of barley, horse harrows would be used as well. On the other hand, none except the

Fig. 1. Stone roller from Newton Abbot in Devon

hand implements might be used until after the sowing, depending upon the land or the individual farmer's tastes and ideas. But so far nothing approaching the modern cultivator had been thought of, unless we regard the heavy ox harrow as such, and it was not until a century later that anything like it was developed.

The 18th century

A variety of tillage and cultivating implements was used in the 18th century, and in some of them we can see quite clearly the basis upon which modern implements of cultivation are evolved. The breaking of clods by hand continued and heavy harrows were also used. The heavy harrow (Fig. 3) in the possession of the Museum of English Rural Life has changed little in basic principles from that illustrated in the Luttrell Psalter. It has five timbers towards the line of draught instead of four, but it has the same number of teeth, forward-pointing as in the Luttrell illustration, on each timber. The cross-bars are four in number instead of five and are mortised through the draught-line timbers. The method of haulage attachment is advanced, but it will be observed that it is on the same side as in the Luttrell Psalter. It will be seen also from the illustration that strength was added to this harrow, not only by the metal bars running directly in the line of draught, but by the shaping of the two outer long timbers. Also, there is some adjustment at the point of draught by means of a notched regulator.

Clearly this harrow is well made, solidly constructed for its rough work, and well designed.

Fig. 3. Heavy harrow. Hampshire, date unknown

Light seed harrows were, of course, also in use, and there were very heavy harrows attached to a bar with a wheel at each end. The illustration (Fig. 4) of an early harrow depicts one of a set of two which was attached to a bar. It is clearly a seed harrow, but it could also be a useful implement for tillage. It will be seen that, although it is of a later date than the first harrow, it is not so well made. Heavier types of wheeled harrows were the earliest cultivators.

In this century also that great figure of agricultural history, Jethro Tull, advocated the cultivation of the soil between growing plants for the purposes of aeration, prevention of moisture loss by capillary evaporation and for the purpose of destroying annual weeds. Horse hoes thus came into use with three or more tines. Two types of blade were fitted to these: triangular, to take the centre of the rows, or L-shaped, as in Fig. 5—although this is a 19th-century development of the early implement—set in such a way as to cultivate as close to the rows as possible.

Another and possibly more direct predecessor of the cultivator was an implement used for making seed furrows. This was triangular in shape and had a wheel at each corner; blades consisted of coulters set in the cross-bars of this frame. The three-wheeled horse cultivator shown in Fig. 6 is one of the many produced in the 19th century, with the triangular frame as its basis.

But we must not overlook the fact that the earliest weeding harrows were a development of the horse rake. These were guided by handles and were provided with a variety of points.

The transport from field to field of these ponderous implements containing so much wood was not without its problems. The simplest method was that used today when expedient; the harrows were turned upside-down on a convenient bough and drawn to their place of work, or a sled was used, or one harrow of a set might serve as a sled for others.

As to rollers, clod-crushers similar to that shown in Fig. 7 were used towards the end of the 18th century and ordinary rollers continued to be made of wood or stone. There were also rollers with projecting pins; these were used in combination with ordinary rollers.

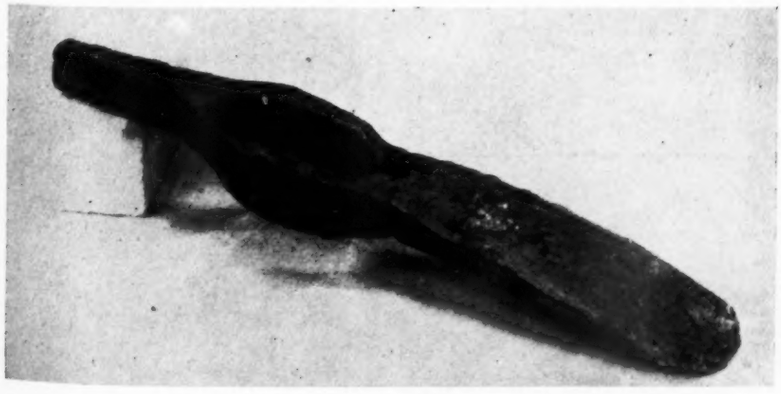


Fig. 2. Cornish tool used for breaking up the heavy ground of West Cornwall. Early 19th century

The 19th century

As the 19th century advanced, the old business of clod-breaking by hand implements became less important and less wood was used in the construction of tillage and cultivating implements. With improvements in industrial tech-

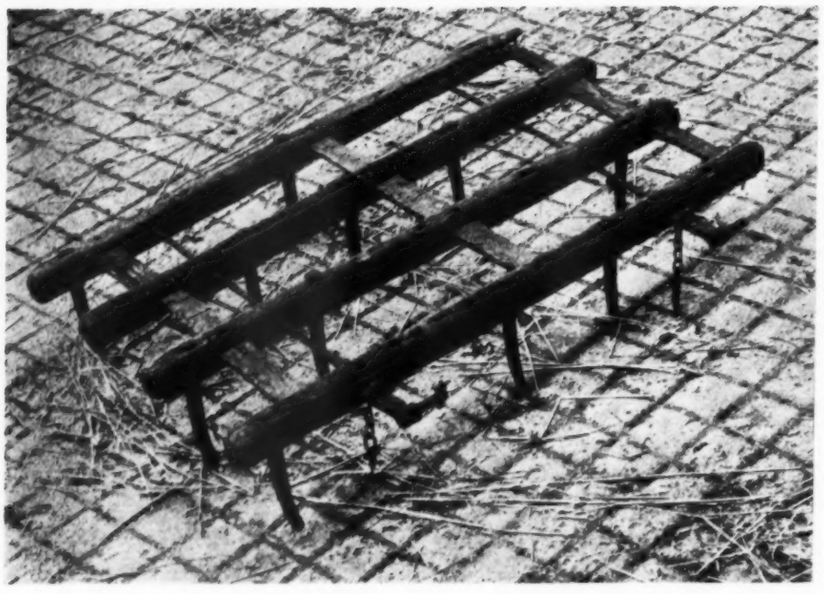


Fig. 4. Seed harrow. Berkshire, date unknown

nique, construction and experiment became easier. The business of finely breaking down the soil between ploughing and sowing became more urgent as various types of drills were brought into use. Obviously, the action of early drills gave in themselves the possible direction of further soil tillage; even as early as the latter part of the 17th century a corn-drill was attempted with a coulter in front to cut through 'carefully prepared land,' with a hopper behind containing the seed. The triangular drilling frames of the late 18th century, referred to above, must surely have produced additional tilth in their use, as did the drilling machine invented by Jethro Tull.

Cultivating now asserted itself in a definite place in agricultural procedures. Machines were made especially for the task of breaking up new land, making a tilth after ploughing, working in artificial manures and other dressings, and generally assisting in the work of preparation for the drill. Fig. 6 shows that they were also adapted for transport; a little careful study will also show how the tines can be lifted forwards, out of the ground, by pressing the long handle at the back downwards, and how the tines are set at the required depth by regulating the wheel on the right of the machine.

Before we come to the earliest successful experiments with steam mechanisation, two types of cultivator deserve more than a passing mention. One is a very practical-looking implement known as the 'Devon Tormentor.' This rightly belongs to the latter part of the 18th century, but it was in popular use in 1810. It contains the triangular-frame construction of many early cultivators, its beams 4 in. square, length about 6 ft. from apex to base, and base 3 ft. 7 in. wide. At the forward apex of the triangle is a tine 15 in. long, with a forward-pointing, arrow-shaped blade, and there are three similar tines equally spaced on the two sloping sides. The rear wheels are 3 ft. in diameter and the front is a 10-in. iron wheel upon a spike set through the beam and projecting well above it. The haulage point is at the apex of the triangle.

Regulation of depth is quite simple and quite practicable. The rear cross-beam is attached to the metal axle between the large wheels by two vertical iron slats, which pass up through corresponding slots in the axle; these slots have regulating holes and pins. The front of the frame is held to the required depth by means of iron rings which fit upon the spike proceeding from the front wheel, the rings being above the beam and held in position by a pin at the top of the spike.

The other cultivator, of about a quarter of a century later, is Finlayson's harrow. Again the triangular frame is used, and the machine has three wheels, the front being a type of castor. It has three rows of large, forward-pointing spring tines, of a design still in use in quite modern implements. Depth regulation is by means of screw adjustment at each rear wheel and by a large lever set in a pyramidal frame above the machine. This lever, worked from behind, will lift the whole front of the frame out of the soil or set it to the same depth as the screw system at the back.

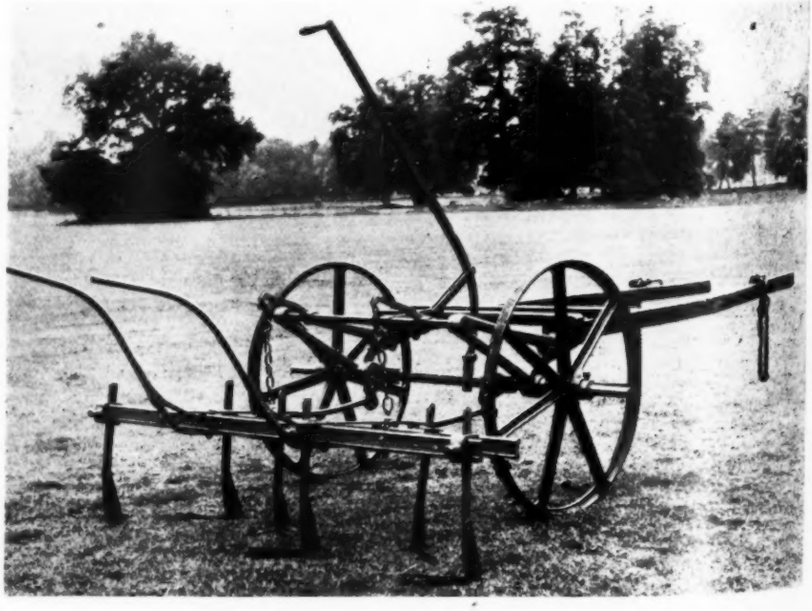


Fig. 5. Guided horse-hoe and toolbar, 1906; used in St. Marybourne

The Museum of English Rural Life's cultivator (Fig. 6) embodies some of these ideas.

Many further modifications in cultivating machines were used in the age of steam, but horse machines were necessarily limited to from three to six points. The points did not vary a great deal in general design, being for the most part modifications of the coulter, arrow-shaped as in the horse hoe or 'Devon Tormentor', or, as in the illustration, something like the tines of a very strong horse rake.

Thus we see in the cultivator ideas borrowed not only from the early horse rake but from the coulter, the share, from early harrows and drills; and from these we may trace again a divided evolution to modern harrows and cultivators of all types, from the simple seed harrows, the various spring tines, to cultivators proper, and sets of discs. We may also trace the origin of modern toolbars; not now very much like the horse rakes and horse hoes from which they evolved, but, as in examples like that shown in Fig. 5, the principles are there.

Before leaving the subject of harrows and cultivators of the first half of the 19th century, it must be pointed out that weight gave place to design, this taking into account the mathematical and mechanical principles of sliding equipment—some, not unlike those which have brought trailer ploughs to their present efficiency, were a much better means of guiding the cultivating implements through the soil than bulk and weight, although, as steam mechanisation advanced, such principles were reversed by some inventors. Up to the middle of this century rectangular forms of harrow were mostly in use, which, drawn diagonally from one point, inclined to swing from side to side. All sorts of shapes to counteract this tendency were tried out—triangular, diamond-shaped and others—until the zig-zag harrow was developed, with sets of two or more attached to a bar. This design remains the same to this day.

Even the historic bush harrow was developed further, the chain harrow being used since the early part of the century. The ancestor of the spiked-chain harrow was an ordinary chain harrow with spikes protruding from the links; also small cutting discs were tried in combination with chains to break up the pasturage roots.

We must remember, however, that early agricultural inventors had not the advantage of industrial technique or materials in the construction of their implements, and it might well be that before the 18th century it was difficult to improve upon the best of implements then in use.

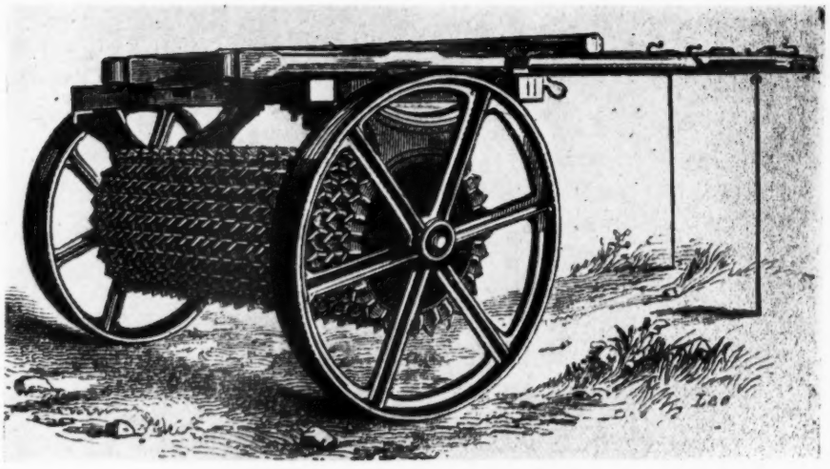


Fig. 7. Clod crusher. From the *Journal of the Royal Agricultural Society of England*, 1851

With rollers, as with other cultivating implements, iron rapidly came into use in the 19th century. Two or more iron cylinders were used, and these rollers give good service here and there to this day. The earliest single-cylinder rollers, like the previous wooden and stone types, were not altogether efficient, however, because on the turn the forward half of the roller retarded the backward half, thus producing a skidding and braking motion. To some extent this was overcome by dividing the cylinder into two halves, but later an ideal solution was found in the development of the ring roller. This was made up of closely-set iron wheels or discs. A curious type of ring roller, with a wooden wheel alternating with an iron one, was in use for some time, possibly built with the object of preventing clogging.

Another ring roller specially designed to prevent clogging was Crosskill's roller of 1841. This had serrated rings alternating with plain rings. The serrated rings were looser in their attachment to the axle than the plain rings, and the play thus produced between these and the plain rings prevented clogging. But one of the most interesting rollers, in view of the later development of disc harrows, is one used in Cornwall about 10 years earlier. This

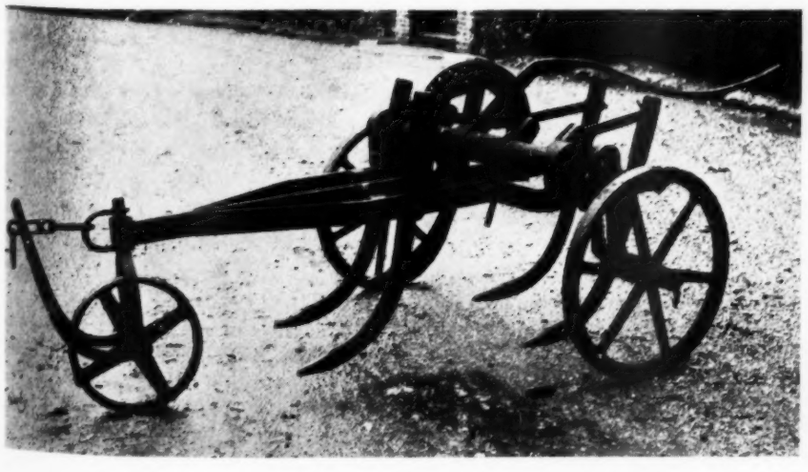


Fig. 6. Horse cultivator, mid-19th century, Oxford

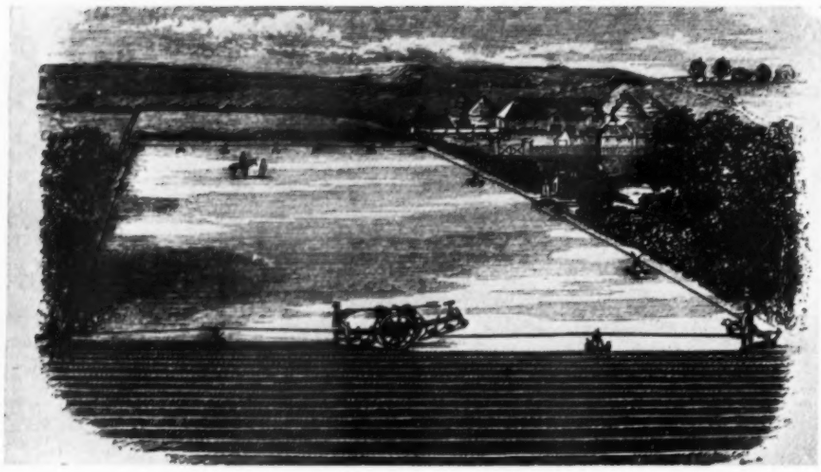


Fig. 8. Steam ploughing and cultivating tackle (Copeman's 'Agriculture, Ancient and Modern', 1866)

was a wooden roller with flat iron discs mounted upon it, the discs being twice the diameter of the wooden roller. Its use, it is said, was for breaking down damp soil. Clod crushers like that in Fig. 7 were also used.

The Steam Age

The second half of the 19th century is generally regarded as the first successful era of farm mechanisation. This is by no means the case. Farm mechanisation started when man began to use draught beasts for his work instead of depending upon his own labour. Steam mechanisation, especially with regard to tillage and cultivation, began merely on the basis of substituting steam for animal draught. This is shown by the very early steam cultivators, which, like the horse-drawn implements, had no more than six stout tines. They were double-ended implements with guiding handles at each end, and a man had to walk behind and guide them across the field or use his weight to keep them steady, as with the horse-drawn implement. At the same time, on heavy land, he would pass his colleagues still breaking down the soil with hand implements.

Cultivators improved as the technique of steam improved; eventually multiple-tined balance cultivators were invented with the driver seated upon them to guide and control (see Fig. 8), or without a driver at all. One or two sets of steam ploughing and cultivating tackle exist and are at work to this day; but it is a fact that the progress most useful to 20th-century farm mechanisation which steam developed was that based upon mathematical and mechanical principles of sliding equipment and not the desertion of these principles in the invention of curious soil-smashing juggernauts.

A few of these deserve mention, *e.g.* Rickett's cultivator was an enormous steam-engine with broad-tyred wheels and athwart the rear of it was a vast screw, like an outsized auger. This revolved as the machine moved forward, scooping up the soil and showering it back again.

Comstock's digger was another strange trailer implement, in which five rows of backward-pointing tines were revolved on the endless belt system, the tines digging into the earth and showering it backwards.

An even stranger erection was Darby's steam digger, with two steam-engines mounted upon very wide wheels. Rows of mechanically-worked tines were mounted behind this machine and a set of disc harrows trailed behind them.

But perhaps one of the most strange —yet perhaps one of the most practicable—ideas with regard to steam cultivation was that put forward by Hackett about 1861. This was intended for use upon very large farms, for it involved the laying down over land of permanent rails 50 ft. apart, and a system of shunting rails was needed at the headlands. The two steam-engines were to run beside each other on two rails, and between them was to be a suspension bridge to which any desired number of cultivating implements could be attached. A shunting engine was to be used on the headlands to transfer this monstrous piece of equipment from one set of rails to another. It was asserted by the inventor that after the initial outlay ploughing, harrowing, scarifying, hoeing, drilling, cutting, reaping, cabbage planting and irrigation could all be done for a few pence per acre.

Strange ideas like these and clod crushers, extirpators, grubbers and other implements too numerous to mention in this short account were invented, but always with the moving steam-engine the great fault was that, however wide the tyres of these giants, they would sink in and become impossibly bogged in soft ground. The most successful attempts at steam mechanisation were those in which the steam-engine remained stationary and drew implements through the soil by means of cables—but we must not overlook the fact that in the age of steam the principles of rotary cultivation as used in modern implements were advanced.

Thus did the old principles of trailer cultivators and harrows persist, and were improved upon not only by the steam engineers, but also by those concerned with animal draught, for steam by no means superseded draught animals and the ideas of both types of cultivating implements are incorporated in farm mechanisation of the present day.

Photos: The University of Reading, Museum of English Rural Life.

Technical News

The May issue of *Fibres (Natural and Synthetic)* contains 'Fibre and Fabric Research,' and 'Technical Progress in Man-made and Synthetic Fibres, Part 1,' by Dr. H. Rathert.

Dairy Engineering for May contains 'World Trends in Dairy Produce.'

The contents of *Manufacturing Chemist* for May include 'Maleic Hydrazide,' by D. J. R. Massy, B.A., 'The Phytosterols of Soya—Chemistry, Properties and Uses,' by A. Matagrin, and Progress Reports.

Food Manufacture for May contains 'Peanut Butter, 1' and 'Choice of Detergents for Food Factories,' by J. C. L. Resuggan.

South African Agricultural Developments

WE have received from our Cape Town correspondent the following recent news of agricultural developments in the Union.

Plum difficulties

At present, plums are the chief worry of the general manager of the Deciduous Fruit Board in Cape Town. The growers look to him to sell a bumper crop this season, but they are worried because the Americans have invaded their best market—Great Britain, where 87% of the entire Union plum crop was sold last year. Plums came to the Cape originally from Japan, and years of grafting and experimenting with different varieties have produced as fine a plum as can be found anywhere in the world. Part of the plum crop goes each year to Singapore and Hong Kong in Dutch refrigerated ships. The first plums to ripen early in December are the Methleys, which are small and tasty. Then come the Santa Rosas, the Beauties and the Eldorados. The Santa Rosa crop, which starts to come on the market before the middle of December and goes on for some weeks, is easily the Cape's most important export plum. Last year nearly 2,000 tons of Santa Rosa plums were exported—40% of the entire plum crop. The Santa Rosa is big and purplish red in colour.

Next to ripen is the Satsuma or blood-plum, so called because of its rich, glowing colour when bottled or canned. On the tree it looks almost black. The Gaviota plum—green turning yellowish red when ripe—comes at the beginning of January and is followed soon by the Wickson, which is very much like the Gaviota in colouring but more like a pear in shape.

Deciduous fruit exports

South Africa's exports of deciduous fruit during the present season, which began with the apricot shipments in November, are likely to reach record figures if the shipping industry continues to provide enough refrigerated transportation. This increase in fruit exports is foreshadowed in the statistics of tree planting in the Western Cape, where the bulk of the Union's export deciduous fruit is grown. The last official survey of the number of fruit trees in the Western Cape was made in 1952 and it revealed that in the planting seasons 1950-51-52 the following trees were planted: Table grapes, 2,100,000 vines; peaches, 1,065,000 trees (but most of them canning peaches); apricots, 842,000 trees; apples, 400,000 trees; pears, 310,000 trees; prunes, 90,000 trees; plums, 63,000 trees. These plantings brought the total number of trees to 3,366,000 apricots, 2,877,000 peaches, 2,204,000 apples, 15,710,000 table grapes, 985,000 pears, 625,000 prunes, 528,000 Japanese plums and 42,000 nectarines. At that time, 1952, 44% of the pear trees, 40% of the apple trees, and considerable percentages of the other trees had not yet reached the production stage. The output of fruit in the present season includes the fruit from these new trees, and it follows that there must be a pronounced increase in the quantity of fruit available for export. The Union's deciduous fruit exports in 1953 amounted to 142,000 tons shipped, yielding a gross income of £6,250,000.

Fruit experiments

The Western Province Fruit Research Station at Bienne Donne, Groot Drakenstein, is experimenting with a number of new and early apple and other fruit varieties to secure better prices both on the European and the South African market. With North American apples competing on the European market again this year, South African fruit growers fear a drop in prices for the bulk of their crop. The fruit seasons in the Northern and Southern Hemispheres are at different times, South African cold-stored apples reach the oversea market from April to the end of November or early December and have to compete with the North American crop, which reaches the European market from July to the end of February. The object of the present experiments is to bridge the gap between February and April and extend the domestic fruit season. Experimental trees of a number of early varieties were issued to farmers in the main apple-growing areas some years ago and have now reached the bearing stage. The Convada red dessert apple is regarded as one of the most promising discoveries. When taken out of cold storage as late as July last year, apples of this variety were still crisp and juicy. Other early varieties which show promise are Melba, Macoun and Zoba, all of which are ready for export during January, February and March. This also means that the local market can be supplied with fresh apples from the end of January onwards and perhaps as early as December. New dessert and canning peach varieties have also been developed. For the period between the Peregrine (mid-January) and the Elberta (mid-February) when no dessert peaches are ripening, the Katherine Ann has been found. This is an export variety like the Peregrine.

Vygie for wheat crops

The cultivation of wheat crops in the Kalahari and other arid parts of South Africa by using the common South African plant known as the vygie (*Mesembryanthemum*) is suggested by Mr. A. Osman, who has stated that there were about 2,000 different varieties of vygies in the Karoo. They drew moisture from the atmosphere and could be ploughed into the ground to supplement the meagre rainfall. They might keep the soil moist for three to five years. If this method worked, the arid Kalahari, Namaqualand and South-West Africa could be turned into a rich granary.

Maize storage

The total capacity of covered storage for maize had more than doubled since 1948, according to an official of the Maize Industry Control Board. In 1948, the total capacity of stores was 15 million bags. It had increased in 1954 to 31 million bags. In October last, 9 million bags had been stored under tarpaulins in the open. Stocks had been drawn from these piles and the amount stored in the open at present was probably between 7 million and 8 million bags. If good crops continued to be harvested, the storage space would have to be increased further, he said. No damage to maize stored in the open had been reported so far in the past few months.

Australian Agricultural News

From our Australian Correspondent

Wheat crops

Australia's wheat crop for the current season is estimated at 155,100,000 bushels—or some 43,900,000 bushels (22.1%) less than last season and the smallest crop since the New South Wales-Queensland drought in 1946-47. According to the Acting Commonwealth statistician, Mr. S. R. Carver, the fall is due mainly to unfavourable weather in New South Wales during the sowing and growing periods. The area sown, 10,499,000 acres, is about the same as in the three previous years, but 25% less than the post-war maximum of 13,880,000 in 1947-48. Mr. Carver estimates the yield at 14.8 bushels an acre—the lowest since 1946-47 when the yield was 8 bushels—and 4.3 bushels less than the record yield of 19.1 bushels in 1952-53. State estimates are: New South Wales, area 2,780,000 acres with production of 36 million bushels and an average yield of 12.9 bushels; Victoria, 2,400,000, 44 million, 18.3; Queensland, 700,000, 17 million, 24.3; South Australia, 1,560,000, 25,300,000, 16.2; Western Australia, 3 million, 32,700,000, 10.9; Tasmania and Australian Capital Territory, 9,000, 100,000, 12.2.

Rice crop difficulties

Thousands of geese are eating the rice crops sown by the private rice-growing organisation near Humpty Doo (about 40 miles from Darwin) almost as quickly as they are sown. Each morning employees of the syndicate, which is backed by American, English and Australian capital, shoot dozens of the geese. They also place lanterns and flares around the paddy fields and use improvised cannon—which go off with a loud report—in an effort to keep the geese away from the crop.

Wheat exports

The trustees of the wheat pool of Western Australia believe, on the evidence of recent charterings, that recent improved rates of exports will be maintained ' at least for the next two or three months.' In the first five months of the current season—from August 1 to December 31—Australian wheat exports totalled 37½ million bushels, or 10½ million bushels more than in the corresponding period of the previous year. The increasing importance of the wheat exports to India, which received 6,848,000 bushels to December 31 compared with only 466,000 bushels to December 1953, and of Germany, which imported 5,154,000 bushels against 658,000 bushels in the same period of the year before, is evident, the trustees state. On the other hand, Ceylon, which has been one of Australia's best customers, imported only 1,238,000 bushels up to December 1954 against 4,393,000 bushels in the same time in 1953. Purchases of Australian wheat by the United Kingdom increased by 640,000 bushels to reach 6,832,000 bushels, but this expansion is to a much lesser degree than the increase of United Kingdom wheat imports from other sources.

New Tractor Engine Oils

The introduction of two new tractor engine oils was announced recently by Shell-Mex and B.P. Ltd. These oils have been designed to give, with a single oil, a correct lubrication of diesel, vaporising oil and petrol tractor engines. Moreover, they are intended to be used in these three types of engine throughout all seasons of the year.

The new oils are called ' Shell Tractor Oil Universal ' and ' B.P. Energol Tractor Oil Universal.'

Farmers with more than one type of tractor engine have hitherto been faced with the complication of carrying stocks of several different types of engine lubricating oil. This has entailed the risk of an incorrect oil being used for a particular purpose and, furthermore, it has required an enormous amount of storage space.

Many advantages are gained with the introduction of these universal oils and of these simplicity is perhaps the keynote, for only one grade of oil is required instead of several. Other advantages claimed for these oils are longer life, easier starting, instantaneous lubrication and engine cleanliness.

Libyan Dates

Dates form the staple diet of the inhabitants of Libya. Lack of processing and storage facilities are the main causes of considerable losses and wastage. Some regions have an annual surplus of dates, which, if processed, could be stored for all-the-year-round consumption and against seasons of cereal crop failure. After having studied the principal causes of wastage, an FAO date-processing specialist set up a pilot project for processing in Tripoli, for which FAO supply the equipment.

Mr. W. H. W. Dowson, FAO date expert, preparing an experimental date confection in the pilot processing plant in Tripoli

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To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books and have a world-wide selling and distributing organisation.

NEW BOOKS

Compound Milling and Associated Subjects

By N. Owen Simmons. Pp. xix + 279, with 197 illustrations. London. Published by Leonard Hill Ltd., 9 Eden Street, N.W.1. 1955. 42s. net.

The large-scale production of balanced rations for the successful feeding of livestock demands a knowledge on the part of the compound and provender miller of:

1. the nutritional requirements of different classes of livestock when fed for various purposes and at various stages of growth;
2. the nutrient composition and dietary value of raw materials suitable for use in the ration;

and

3. the means whereby raw materials alone and in mixtures can be handled and suitably processed.

The compound miller's knowledge of items 1 and 2 should enable him to formulate rations which are suitably balanced in major ingredients and in vitamins and minerals for specific purposes, while the extent of his knowledge of item 3 should be such that he can convert either an individual feeding stuff or a specially formulated blend into a form which will be well liked, well digested and well absorbed by the animal or bird. Mr. Simmons's book is concerned mainly with this last aspect of the science of compound milling, although it does contain a contributed chapter—and the longest chapter of the book—which is devoted to item 2. The important subject of the nutritional requirements of various types of livestock and the formulation of blends is, however, dealt with very sketchily, being discussed in about eight pages. This is a pity; if in a second edition Mr. Simmons were to give this aspect of the subject the attention it needs his book will not only become much better balanced, but also of greater value as a practical guide.

Section 2 of the book, which deals with plant and processing and which accounts for about 85% of the text, is wide in its scope, covering the whole of the practice of compound and provender milling from the intake and storage of raw materials to the weighing, packing and storage of finished products. It reviews in detail and with a wealth of illustrations, which include photographs and line drawings, the plant and processes involved in weighing, cleaning, conveying, exhausting, conditioning, drying, grinding, mixing, blending, cubing, pelleting and flaking. The illustrations include 18 flow sheets presenting the sequence of operations involved in specific manufacturing processes.

The text is well written and clearly explains the construction and method of operation of the various machines, an object not always easy of attainment, but Mr. Simmons has had the advantage of serving for many years as a technical member of the staff of a firm of milling engineers which manufactures many of the machines used for for compound and provender milling. Errors and misprints are few, although there are some inconsistencies in the founts used for sub-headings and a few incorrect textual references to figure numbers. These defects, although perhaps slightly annoying, are only minor blemishes and do not seriously detract from the value of the book as a tutorial manual for the student and a practical reference book and guide for the compound and provender miller.

A. J. Amos

Crop Protection

By G. J. Rose, B.SC. Pp. xxii + 224, illustrated. London. Published by Leonard Hill Ltd., 9 Eden Street, N.W.1. 1955. 30s. net.

This is an excellent book and without doubt will be of inestimable value to the cultivator, for whom it was primarily written. Nevertheless, this book will have an appeal for most agriculturists, whether they be scientist or lay. The author has produced a practical guide to the protection of crops from the initial seed stage to the stored product. In addition, it is an aid to the planning of an intelligent programme of measures for combating insect pests, fungus diseases and competing weeds.

The book is admirably written, concise and logical. This is a difficult combination to achieve, particularly on a subject as vast as crop protection, but Mr. Rose has treated the subject matter both wisely and well.

There are four main sections, the first of which is devoted to general considerations, cultural control and types of formulations. Section 2 deals with chemicals, weedkillers, insecticides, fungicides and rodenticides, and Section 3 describes the equipment and machinery for applying these materials. The last section is a short but useful summary on the protection of stored products; it includes a list of control measures that can be adapted for more than 40 diverse and important crops.

The illustrations are helpful and of good quality; there are 13 useful tables and the book is adequately indexed.

The way in which the vast store of material has been treated makes this volume an indispensable source of information and a reference work for everyone interested in, or actively occupied with, the problem of protecting his crops.

Animal Breeding

By A. L. Hagedoorn, PH.D., with a memoir by John Hammond, C.B.E., M.A., D.SC., F.R.S. Fifth edition. Pp. xix + 364, illustrated. London. Crosby Lockwood and Son Ltd. 1954. 18s. net.

The fifth edition of this well-known work has a melancholy significance attached to it, inasmuch as it appears after the death of the distinguished author, which occurred in Holland in November 1953. In a note by the publishers it appears, however, that the whole of the manuscript had been revised by Dr. Hagedoorn and was in the printer's hands before his death. The proofs have been corrected by his widow, who is herself a geneticist of distinction and who collaborated with her husband in much of his work.

The present edition has been extensively revised and presents much new material; it is prefaced by a short memoir by Dr. John Hammond, in which tribute is paid to the life and work of the author.

Dr. Hagedoorn was one of those rare scientists who has specialised in the study of genetics from the point of view both of the plant breeder and the animal breeder. A plant breeder in his earlier days, he later became attracted to the study of animal genetics and realised that the study of animal

genetics had lagged behind plant breeding and that, although the broad principles of genetic inheritance apply equally in both spheres, methods, in work with animals, are largely overlaid by empirical ideas and dogmas which have become superseded in plant breeding. It was with the idea of helping to place animal breeding on the same basis of ascertained fact and rational method as plant breeding that the book was first written. The fact that it has already passed through five editions is abundant testimony to its value and to the wide appreciation and recognition which it has achieved. A factor that has greatly contributed to this is that Dr. Hagedoorn was himself not only a distinguished geneticist, but also a practical breeder of livestock and, as such, able to appreciate the outlook and the difficulties of the practical man.

As Dr. Hammond remarked in a foreword to the first edition: ' If the modern science of genetics is to be of any help in improving the quality of our animals, its principles and their application must be made known to the farmer himself. This the present book sets out do do.' This is even more true in regard to the present edition, and the book can be cordially commended to all concerned with the breeding of farm and other animals.

The book itself is excellently produced and well illustrated; an added attraction is the very reasonable price.

Plant Climate and Irrigation

Edited by Sydney A. Searle. Pp. xii + 156. Chichester Press Ltd. 1954.

In a foreword to this book Dr. J. P. Hudson, of the Department of Horticulture, University of Nottingham School of Agriculture, writes: ' It is only recently that attention has been focused on factors which can cause delay or loss of crop without any visual symptoms of distress in the plants concerned. . . . Horticulture is the art of growing certain types of plant efficiently and cheaply. It is still an art or craft rather than a science, since many of the decisions made by a grower must be based mainly on his judgment; but any accurate knowledge of the probable effects of a cultural treatment will strengthen the cultivator in applying his art to the production of crops.'

Dr. Hudson continues: ' The problems involved in glasshouse production are many and complex. We still know all too little about the effects of various factors of growth rates and rely far too much on the rather clumsy, hit-and-miss methods of environmental control that served their purpose when coal was cheap and labour plentiful. Under the much more stringent conditions of today, with heavy capitalisation and rising costs, the glasshouse grower can only hope to make a good return on his investment if he can produce heavy yields of high quality at a low cost.'

This book is a symposium of articles which deals with this express problem. In the pages of this book the latest research work covering plant environment in its widest aspects, both in the field and under glass, has been collected together and written in a form readily understandable by all those concerned with agricultural and horticultural food production.

More than 200 recent publications dealing with plant climate and soil moisture have been reviewed and much new work is included.

The climatic factors affecting plant growth and development are discussed in detail. To all those engaged in growing, the measurement of these factors can provide a valuable guide, and in the glasshouse, where a large measure of control over climate is possible, measurement of the more important factors would appear to be essential for successful crop production.

Subjects such as ' The Measurement of Soil Moisture,' ' The Effects of Different Water Regimes on the Growth and Yield of Tomatoes ' and ' The Calculation of Crop Water Requirement ' have been treated by such well-known experts as B. A. Eastwell, Francis R. Frampton, P. J. Salter and Sydney A. Searle.

The volume is printed on first-quality paper and contains many helpful illustrations.

A Survey of the Agriculture of Kent

By G. H. Garrad, O.B.E., N.D.A. Pp. iv + 232, illustrated. London. Royal Agricultural Society of England. 1954. 21s.

The Research Committee of the Society has decided to break new ground in the field of operational research by the publication of surveys of the agriculture of each county. They are to be similar to the surveys prepared by the old Board of Agriculture more than 100 years ago.

The first half of the 20th century has brought a nation-wide change in our agriculture which has been more remarkable in character and more swift in its development than any other period of comparable length in our history.

Thus it was considered desirable that the effect of these changes in the face and activities of the English countryside should be placed on permanent record. The aim of the surveys is to give a general conspectus of present-day agriculture of the county, together with any outstanding achievements. They are to be a record not only of what has happened, but also a pointer to the way improvements might be made so that the wealth of available knowledge can be applied for the benefit of any interested persons.

Kent is an appropriate starting point for a series of county surveys, for in earlier days it must have been the gateway through which so many ideas and improvements passed from the Continent to penetrate the practices of Britain. Kent thus forms the first subject of the series.

The author has spent 40 years working among the farmers of Kent, principally as an agricultural organiser and adviser, he is well informed on the agricultural use and potentialities of the county and, moreover, he is aware of the changes that have taken place during this time.

Although Kent is often called the ' Garden of England ' and it contains a larger proportion of good and medium quality land than any other home county, it also contains much poor land. Kent is, in fact, a county of contrasts, varying from deep rich loams to areas of poor, dry, chalk downland and wide belts of wet stubborn clay. Owing to its basic geological conditions, the nature of the soil probably varies more frequently and more abruptly than in any other county of similar size.

The facets of Kent farming are many and widely varied. There are, for example, the famous sheep-fattening pastures of Romney Marsh, the cherry orchards around Sittingbourne and on

the deep brick-earth soils of North Kent, the fruit- and hop-growing in the Medway valley, the early-potato-growing district north of Rochester in the Hundred of Hoo etc. Despite all these specialised branches, general mixed farming plays an important role in the agriculture of the county.

Although only ninth in size, Kent employs more agricultural workers than any other administrative county in England and Wales because of the high labour requirement in the growing of fruit and hops, market gardening and glasshouse crops.

The survey is well presented and includes many photographs, maps, graphs and tables; it is attractively bound and lettered and worthy of a place in the library of all agriculturists.

Reports and Publications

The Journal of the National Institute of Agricultural Botany, 7, No. 1, 1954—National Institute of Agricultural Botany

There is a mine of information about cereals in the latest issue of the *Journal of the National Institute of Agricultural Botany*, which has recently been published. It includes a full record of the proceedings of the crop conference held in December 1953, when the discussions centred around the barley crop, quality in wheat and sugar beet. Extensive series of winter wheat variety trials and of spring oat trials are reported. Oat quality is covered by a paper from the Cereals Research Station on reduced germination from decayed embryos.

Crops other than cereals are not ignored, for this journal includes trials reports on early cauliflowers and brussels sprouts, a description of climbing french bean varieties, and an article on the identification and classification of lucerne strains.

Report of Recommendations Committee, 1954. Association of British Insecticide Manufacturers. 2s. 6d.

A booklet summarising recommendations for the use of chemical weed-killers in British agriculture has been issued by the British Weed Control Council.

This authoritative document is the unanimous report of a committee representing the Ministry of Agriculture and Fisheries, the Agricultural Research Council, the National Farmers' Union, the Association of British Insecticide Manufacturers and the British Agricultural Contractors' Association.

The report is divided into three sections. The first gives recommendations on the type and amount of weed-killer (herbicide) to use for selective weed control in field and vegetable crops, in sports turf and in forest nurseries. The second section gives recommendations for the use of non-selective herbicides and soil sterilants and for the control of shrubs, trees and other woody weeds; it also indicates recommendations for the use of chemical potato haulm killers and pre-harvest sprays for lucerne and clover for seed. In these two sections appear three tables relating to weeds of agricultural and field crops, to weeds of sports turf and lawns, and to woody weeds, classifying in all the susceptibility of over 200 weeds to the commonly used selective herbicides. The third section gives general information on the principles of spraying, on the matters of law and on new herbicides.

Vegetable Oils and Oilseeds, 1954. London: H.M.S.O. 5s.

World supplies of vegetable oils available for food uses in 1954 were appreciably greater per head of the population than in pre-war years. 'Vegetable Oils and Oilseeds, 1954', a recently published review of production, trade, utilisation and prices, shows that total world output of vegetable oils in 1953-54 was the highest ever recorded and some 25% above the pre-war level. Preliminary details for 1954-55 indicate that a very high level of production should again be reached, but that world stocks are probably lower than a year ago. The Commonwealth accounted for a quarter of world exports in 1953, thereby maintaining its pre-war position. Free market prices of most vegetable oils used in the manufacture of margarine and cooking fat declined during 1954, but those of the industrial group strengthened towards the end of the year.

This report contains detailed statistical appendices showing the annual available supplies of vegetable oils in some important consuming countries, the production of soap, margarine and compound cooking fat, with the utilisation of oils and fats in these commodities, a section on whale-oil production, trade and prices, and a new appendix on import duties in the U.K., Canada, the U.S.A., France, Western Germany and the Benelux countries.

Pasture and Fodder Production in North-West Europe—Organisation for European Economic Co-operation

This report is issued exactly as written by the experts and is divided into two parts: Part I sets forth general conclusions and recommendations applicable to North-West Europe as a whole; in Part II will be found a description of the position in each of the countries visited, together with recommendations for development at the national level.

Quarterly Progress Report, No. 11—West African Institute for Oil Palm Research

This is a report from the Director and it deals with the administration and work of the various divisions of the Institute for the three months ending December 1954.

Major and Minor Elements

This is a report by W. J. Hudson and F. Cradock dealing with the deficiencies of major and minor elements in pastures and crops in New South Wales. It is published by the New South Wales Department of Agriculture.

Report on the Provision of Agricultural Education of University Degree Standard in the British Caribbean Territories

In this work is embodied the report by Sir Robert Wood to the Secretary of State for the Colonies for the provision of advanced agricultural education in the British Caribbean Territories. The author concludes by saying that he hopes the standards for training and recruitment will not be lowered from the standard required for the Colonial Agricultural Service generally.

FARM MACHINERY

Mechanical Recorders for Farm Machinery

The demand for more efficient production, maintenance and control, which has spread in this country since the war, has extended to the agricultural industry and English Numbering Machines Ltd. (the largest producers of numbering machines in Europe) are being called in to develop and produce what are in essence counting devices to provide a visual record of a mechanical function arising from the use of tractors, seed drills, harrows, combines, etc.

Post-war progress of the British agricultural machinery industry has been one of the highlights in our economic recovery, with its natural impact on traditional methods of farming; hence the need for some form of visual control of machines and equipment by which the farmer can efficiently maintain his equipment and, in the case of balers, drills and harrows and tractors, check work undertaken.

Usage of counters or figure wheel recorders on certain categories of farming machinery is not new; acreage meters, baler counters and tractor-hours recorders were installed on American equipment before 1939, but the use of the counter-type hours recorder in this country was probably instigated by the Armed Forces, who installed such instruments on diesel-engined equipment used during the last war.

The problem was the design and manufacture of a mechanical recorder at a low price and sufficiently flexible in design to cater for a wide variation of engine speeds, to read in hours for any stated mean speed, and capable of withstanding continuous operation at rates up to and at times exceeding 3,000 r.p.m. The final outcome was to employ an epicyclic gear train, *i.e.* a series of sun and planetary gear motions mounted on a single spindle, a method that is fully patented. This design, as opposed to the costly manufacture of worms and worm wheels, ensures low manufacturing costs, but gives gear ratios in a standard unit variable from 1:1 up to 4,580,000 revolutions per single figure reading.

Developments using the standard recorder have been very progressive, using external gear boxes, brackets etc. to effect standard installations to many makes of tractors and diesel engines, such as Massey-Harris, David-Brown, Perkins, Fordson Major, Bolinder Munktel, Fiat, Lister, Dorman, Enfield, Marshall, Atlas Diesel etc. There was, however, the problem of equipping tractors which had no positive drive location, including the Ferguson range and also the above machines manufactured prior to the provision of a take-off engine drive. Many farmers utilise several tractors, not standardising on one particular type, which has resulted in having some machines recorder-equipped and some being confined to a handwritten log.

There is sufficient clearance behind the pulley of the Lucas 6- and 12-volt generator to fit a thin steel gear allowing a direct gear drive to the recorder unit. A prototype was made and tests were undertaken with pronounced success. One factor that needs emphasising at this point is that the speed rating of a generator is substantially in excess of engine speeds, in some cases nearly 2:1. No difficulty was or has been experienced in this respect from any prototypes or initial production recorders, as the standard ENM recorder is rated up to an 8,000-r.p.m. shaft speed.

The practical aspects of the initial installation revealed several problems. There are two different generators normally used—one 4 in. in diameter, the other $4\frac{1}{2}$ in. in diameter—and the recorder must be attachable to either. Generator shafts were also of differing diameters and the steel gear must fit both. Depending on the age of the generator, three thicknesses of flange would be met and the recorder shaft must be of the correct length for each. On some tractors the whole unit must be swung down so that it will clear the decompression lever, and the recorder shaft lengthened so that it will not foul the belt-adjusting link. All these variations had to be taken into account and low cost factor to be remembered. It was decided to produce complete packs which would meet any requirements likely to be found on any tractor in the field.

The new innovations cover all variables for generator installation and final pre-production models incorporating a nylon moulded drive gear on

An hours-recording machine in position

the recorder shaft, ensuring lightness of drive and friction-free running, were fitted to tractors at Newton Longville and Adstock Manor, and Massey-Harris-Ferguson also undertook field tests. All these tests proved to be an unqualified success. It was ascertained that fitting could be accomplished in less than 25 minutes even if the generator had to be dismantled from the tractor to enable the pulley to be removed. Fitting is simply a matter of locking the driving gear behind the generator pulley and strapping the recorder to the side of the generator in the appropriate reading position.

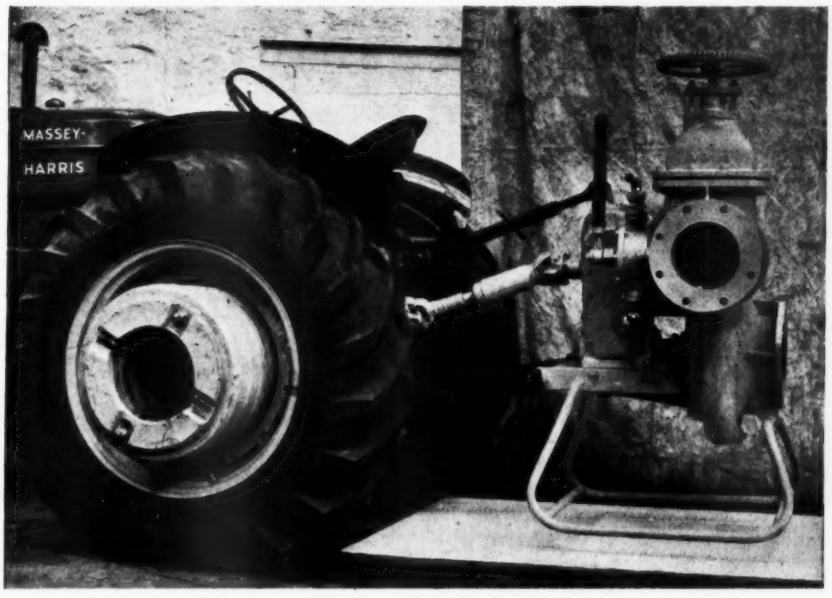
Mole Drainer

The use of mole drainers, for the rapid and economical draining of bog and marshlands without the costly laying of pipes, has become well established, and experiments over a number of years have proven that when cut under proper conditions the mole drain will remain open and effective.

The BNM (Bord Na Mona) mole drainer was originally designed for draining peatlands, where it was so successful that a modified design, having the same unique features, is now being introduced for ordinary land drainage.

The principal features of the BNM mole drainer are that the mole is so suspended in relation to the towing unit that it will cut, at any predetermined depth, a drain which will run perfectly true and parallel to the average ground level or slope, irrespective of any irregularities on the surface. By using the depth adjusting mechanism during cutting, the operator can grade the mole when working on level ground, thus leaving a drain with an invert gradient, again irrespective of surface irregularities.

The BNM mole drainer



D-type irrigation pump in position

Owing to the fact that the mole will always find the depth for which it has been set, by starting with the mole hanging low in the main drain as with the tow bar on the ground, a sharp grade can be given to the first few feet of mole drain as the mole is pulled up to the set depth.

The BNM will cut drains to a depth of up to 3 ft. 4 in. below the surface.

A 3-Ton Spreader

In response to numerous requests from farmers, Salopian Engineers Ltd. have introduced the No. 2 'Even-spreader' with a capacity of 3 tons. This power-driven spreader, with its wider spread and larger capacity, is designed to make the most of every kind of manure.

The body is of all-steel-welded construction and the drawbar of improved pressed steel all-welded. The axles incorporate a completely new design of double-row roller bearings, the whole assembly being totally enclosed and pressure-lubricated by accessible grease nipples. The beater blades are of the latest type one-piece malleable iron castings. The well-proved riveted cutter bar assemblies, bolted to pressed-steel cutter bar brackets, are incorporated in the primary and secondary cutter bars. The conveyor chain assembly consists of sturdy malleable iron link conveyor chains and the conveyor bars run on timber runners.

Irrigation Pump

An 8-in. D-type irrigation pump, developed for use with British Standard Two hydraulic three-point-linkage tractor mountings, has been introduced recently by Gilbert Gilkes and Gordon Ltd.

The pump is capable of an output of 2,000 gal. per minute at 30 ft. total head and is primarily designed for irrigation purposes.

The unit can be easily mounted on to the tractor in a similar manner to any linkage-mounted appliance, the drive being by the usual Hardy Spicer-type couplings through an oil bath integral gear case.

The unit is robustly constructed and, with a view to maintenance by unskilled labour, all parts are easily assembled and maintained.

The pump can be supplied complete with suction pipe, strainer, sluice valve and hand-operated primer. The standard construction does not incorporate a foot valve, but if desired the pump can be operated with a normal foot valve and primed by filling through a large hand hole which is mounted on top of the pump casing.

The pump unit is mounted on a substantial sub-frame to enable it to be easily picked up by the tractor linkage.

35th Brussels Agricultural Machinery Show

Belgium, who has been behindhand for many years in agriculture, has made tremendous strides in the 10 years since the end of the war and is now not only a rapidly developing agricultural country—her farming industry comes third after steel and coal mining —but she is also well on the way to producing her own farm machinery, and the recent 35th Salon de l'Agriculteure Motorisée at the Palais du Centenaire, Brussels, was a first-class object lesson in that respect.

First held in 1908, this great agricultural machinery show is today Europe's foremost market for tractors, harvesters and farm implements, and Monsieur Van Acker's Liberal Government with its ' open door ' policy has freed foreign exhibitors from those paralysing import licences which almost strangle the trade today in France. They realise in Belgium that it would set their country back many years were they to protect their local industry at the expense of restricting rapid farm mechanisation.

Today 72% of the country's total area is under cultivation and the number of tractors has jumped from 2,956 in 1948 to 22,000 at the end of 1954. Moreover, colonial development in the Belgian Congo is progressing at great speed, with cotton fields extending from Elizabethville to Leopoldville.

Highlights of this year's Salon were, above all, the first tractor ever built in Belgium, the Galman diesel, two self-propelled combine harvesters manufactured by Claeys and Excelsior at Zedelgem, two new potato harvesters by Gebroeder Stevens of Poperinge and Ypres, and the Decov harvesters by Decloedt Frères. A new oil-fired glasshouse heater, made by Wanson of Brussels and called the ' Thermobloc,' also aroused a great deal of interest.

Very few British firms were showing at Brussels this year, except for the four largest tractor manufacturers and the manufacturers of the Wolseley electric fencer and the Fordham drinking bowl. This seems a great pity, for Brussels not only serves Belgium and the Belgian Congo, but also Holland and Luxembourg, neither of which has a large agricultural show. The Germans were quick to realise the importance of the exhibition and Western Germany's Minister of Agriculture, Herr Lübke, paid an official visit to the exhibition. He told Belgian farmers that if their own industry or British manufacturers could not supply implements fast enough, Western Germany was ready to fill the gap.

Belgium would be an excellent market for British crop sprayers, potato harvesters and planters, manure spreaders and swath turners, for these are implements that are not produced in Belgium and they will be imported from Germany unless Britain can put in a better and more representative appearance next year.

Sweden's new BM/55 diesel tractor and the MST-751 combine harvester exhibited at the 35th Brussels Agricultural Machinery Show

Progress in Morocco

Agricultural production has benefited enormously by modern farming techniques which are now being applied in all domains. For many crops the limit of production is being reached and yields cannot for the moment be improved. But overall output is still rising because of the introduction of new crops, such as rice, tobacco, cotton and the extension of citrus and other fruit plantations.

Another industrial crop, eucalyptus trees, is being exploited on a large scale and will ultimately supply a new local industry, *i.e.* cellulose extraction, which will doubtless have an important influence on the birth of a Moroccan plastics industry.

This is the result of scientific knowledge as applied to the French Protectorate of Morocco; it is also true to say that scientists and engineers in Morocco have contributed their own share to progress in many ways.

One example that might be cited is the work of a Casablanca agricultural engineer, Georges Rognon, who has invented the world's first successful automatic harvester for peas, lentils, beans and similar crops. It was used on a Moroccan farm and harvested 75 acres of peas in a single day.

Erratum

In the paper ' New Trends in Lucerne Seed Production in the United States ' by Dr. C. de Fellner, 7, 1955, 149, the fifth line in the second column on p. 151 should read ' spectacular. 4.07 million lb. . . .'

WORLD CROP REPORTS

WORLD

Cotton production. World cotton production in 1954-55 is now estimated at 36.2 million bales (of 500 lb. gross) representing an increase of 1.5 million over an earlier estimate but 1.8 million less than last year's estimate of 38.0 million bales. The U.S.A., Mexico, Central America and Brazil accounted for most of the upward revisions since the last report was issued in October 1954.

The 1954-55 production in the U.S.A. is less by 2.9 million bales than that of a year earlier, and production in foreign non-Communist countries is larger by 1.3 million bales. Production in Communist countries as a whole apparently declined slightly with an estimated decrease of 400,000 in China partly offset by an increase in the Soviet Union.

The sharp rise in foreign cotton production in 1954-55 resulted mainly from increased acreage in contrast with the application of acreage restrictions in the U.S.A. In the two years prior to 1954-55 cotton acreage in most of the major foreign producing countries was restricted in favour of 'grow-more-food' programmes or was voluntarily reduced by farmers because of more favourable prices for food crops and tobacco than for cotton. The sharp upturn in foreign cotton acreage in 1954-55 was attributed in recent reports to three principal factors: (1) low world wheat prices that enabled these countries to import low-priced wheat and divert more land to cotton despite a chronic deficit in food crops in many surplus cotton countries, (2) the opening of new irrigation systems and (3) reduced cotton acreage in the U.S.A. coincident with depleted stocks and rising prices of cotton in foreign producing countries at planting time.

The outlook for 1955-56 is for further expansion of at least 500,000 bales in foreign production mainly in Mexico, Central America, Pakistan, Egypt and other Near-Eastern countries and West Africa. In all of these countries larger official goals have been announced or larger crops are forecast privately.

Lentils. Preliminary estimates of lentil production in 11 reporting countries totalled 8 million bags in 1954 or about the same as in 1953. These 11 countries include most of the lentil production in the Americas, Europe, the Middle East and Pakistan. Excluded for lack of data is the production of India, Iraq, all of North Africa except Egypt and several large producers in Asia and Eastern Europe.

The lentil production reported includes most of the lentils which enter international commerce, the non-reporters being mostly among the non-traders. Several of the reporting countries reported increased production in 1954, ranging up to 27% above 1953. Egypt, usually a sizable exporter, produced 27% more in 1954 than in 1953. Syria, a moderate exporter, reported 24% more than in 1953 and Chile and Argentina, both large exporters, reported 18% larger production in 1954.

The most significant decreases in production were reported by Turkey, one of the world's larger exporters of lentils, and by Pakistan, a non-trader for the most part. Turkey reported 10% less production and Pakistan 23% less than in 1953.

Among the large importers of lentils only France reported a significant increase in production. The 1954 crop in that country was 40% above 1953 but totalled less than 300,000 bags.

World lentil trade, when last summarised, totalled about 1.5 million bags annually. The larger exporters were Turkey, 475,000 bags; Argentina, 282,000 bags; Algeria (1954 production not yet reported), 271,000 bags and Chile, 182,000 bags. The larger importers were France, 314,000 bags; United Kingdom, 300,000 bags; Germany, 271,000 bags and the Netherlands, 156,000 bags. The three countries last named do not produce lentils in commercial quantities. U.S.A. imports have totalled 25,000 to 75,000 bags per year for several seasons, Argentina and Chile being the principal sources.

Barley and oats crops. World production of barley and oats in 1954-55 is now estimated at 137.4 million short tons. This compares with 133.9 million tons in 1953 and the 1945-49 average of 114.9 millions. Although the current estimate is slightly less than the first forecast on October 11, 1954, this would still be one of the largest out-turns recorded for these grains. The net reduction from the earlier estimate was in oats, with the bulk of the reduction in North America.

World production of barley, placed at 2,825 million bushels, is only slightly above the 1953 crop but is 30% above the 1945-49 average. Production of oats is estimated at 4,350 million bushels, which is 5% larger than in 1953 and 11% more than the 1945-49 average. World production of these crops is about evenly divided on a tonnage basis with barley accounting for 49% and oats 51% of the estimated world total.

Europe

European production of barley and oats is smaller than in 1953 as a result of reduced acreage and smaller yields. The barley crop is estimated at 825 million bushels, slightly below the large 1953 out-turn but sharply above average. Considerably expanded barley acreage in recent years, especially in France and the U.K., accounts for a good part of the gain over the average periods. Production of oats in Europe, estimated at 1,355 million bushels, is down 90 million bushels from the 1953 harvest. Reduced acreage is responsible for a good part of the decrease, with the area of 29.5 million acres the smallest of any recent year. Reductions in acreages seeded to oats have been widespread in Eastern as well as Western Europe.

U.S.S.R.

Low production of feed-grains in the Soviet Union apparently resulted from drought. Damage appears to have been especially serious in the important producing Ukraine, the Volga basin and some other regions.

Asia

In Asia production of barley and oats is estimated to be moderately below the 1953 out-turn, principally because of reduced crops in Turkey. The total of 837 million bushels of barley compares with an estimated 870 million bushels in 1953. This is still

well above average since acreage has been expanded considerably in recent years. The 1954 crop of oats is estimated at 107 million bushels compared with 113 millions in 1953 and the 1945-49 average of 84 millions. As was the case for barley, the acreage under oats shows a substantial increase in recent years.

Africa

Barley production in Africa is estimated at 156 million bushels, approximating the 1953 production and about 46% above the 1945-49 average. Increased acreage and better yields than in that average period account for the comparatively high level of 1953 and 1954. The crop of oats in Africa, estimated at 23 million bushels, shows no significant change from the 1953 harvest, which was an average crop.

North America

In North America estimates for both barley and oats were reduced from the level of earlier forecasts. Production of both grains is still, however, somewhat larger than in 1953 and well above average. Barley production for the Continent is now estimated at 554 million bushels compared with 512 millions in 1953 and the 1945-49 average of 424 million bushels. A substantial increase over the 1953 crop in the U.S.A. more than offset the reduction in Canada's out-turn.

The increase in the U.S.A. is mainly due to the large acreage increase with yields only slightly above the large yields of 1953. Yields in Canada, in contrast, averaged only 22.4 bushels per acre compared with 29.4 bushels last year.

Production of oats in North America is estimated at 1,816 million bushels compared with 1,620 millions a year ago. The current estimate is also well above average. The near-record production in the U.S.A. offset the small harvest in Canada. The U.S. production of 1,500 million bushels has been exceeded only once, in 1945. The current crop is about 290 million bushels above the 1953 production. That substantial increase is due to increased acreage and sharply higher yields.

South America

The present information on South America, where the harvest has just been completed, points to a better-than-average crop of both barley and oats. Barley production is tentatively set at 70 million bushels compared with 68 millions a year ago and 53 millions, the average for 1945-49. Acreage is well above that average and yields are reported to be larger. No official estimates are yet available for Argentina, the ranking producer of the area, but private estimates indicate that the barley crop may be about 45 million bushels. That compares with 41 millions a year ago and the 1945-49 average of 36 million bushels. It is still, however, somewhat below the record production of 54 million bushels in 1952-53.

Production of oats in South America is now estimated at 85 million bushels. That compares with 80 million bushels a year ago and the 1945-49 average of 57 millions. The gain over the average period is attributed to expanded acreage and higher yields. Argentina's crop is about 75 million bushels, according to private estimates. This is the only producer of real significance in the area.

Australia

Production of these crops in Australia is considerably smaller than the good 1953-54 harvest. The barley crop will be about 30 million bushels, well below the record crop of 45 million bushels a year earlier. This is, however, about double the average produced during 1945-49. Production of oats is estimated at 35 million bushels, well below the harvests of the past two years despite a slight increase in acreage. Adverse weather conditions and heavy grazing of the growing crop account for the decline.

Crops and Markets.

SWITZERLAND

Agricultural policy. The Swiss Government has appealed to farmers to expand the area under cultivation in the country from 270,000 hectares to about 280,000 hectares over the next two years, in order to achieve a better balance between productions of milk and slaughter cattle and harvests of the major crops. The Government's proposal aims at making Switzerland self-sufficient in feedingstuffs, at avoiding excess production of milk and slaughter cattle, and at raising output of bread grains, oats, barley, maize, rape, beetroot and vegetables for canning.

ARGENTINE

Grain prospects. Revised official estimates of 1953-54 crops are as follows: Wheat, 6,200,000 metric tons; linseed, 410,000; maize, 4,708,000; oats, 991,200; barley, 893,600; rye, 607,200; sunflower, 333,500; and groundnuts, 167,300. These revisions are fractionally above previous provisional estimates except for rye and maize, which are slightly lower.

The wheat area for 1954-55 is now put at 6,332,700 hectares, compared with 6,353,900 in 1953-54, while the area under linseed is put at 783,800 hectares against 732,300.

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on March 1, 1955, have been summarised by the Ministry of Agriculture.

Weather conditions. The weather during the first week of February was mild with heavy rain in south-western districts. Colder weather with considerable snowfalls followed and continued throughout the rest of the month.

Cultivations and sowing. With the exception of a little work on some lighter soils early in the month, cultivations and sowings have been practically at a standstill. Work is now decidedly in arrears.

Autumn-sown crops. Many crops were under snow during the latter part of the month and the following reports are based generally on the condition of the crops before they became snow covered.

Wheat was satisfactory on the whole and did not appear to have suffered frost damage; deterioration due to waterlogging is reported from some areas.

Barley was generally satisfactory.

Oats. Early sown oats were satisfactory but some later sowings were rather thin.

Rye was generally healthy.

Beans. In some areas crops were snow covered for much of the month and it is difficult to assess whether the wintry conditions have affected these crops. Prior to the snow, beans were generally a satisfactory plant.

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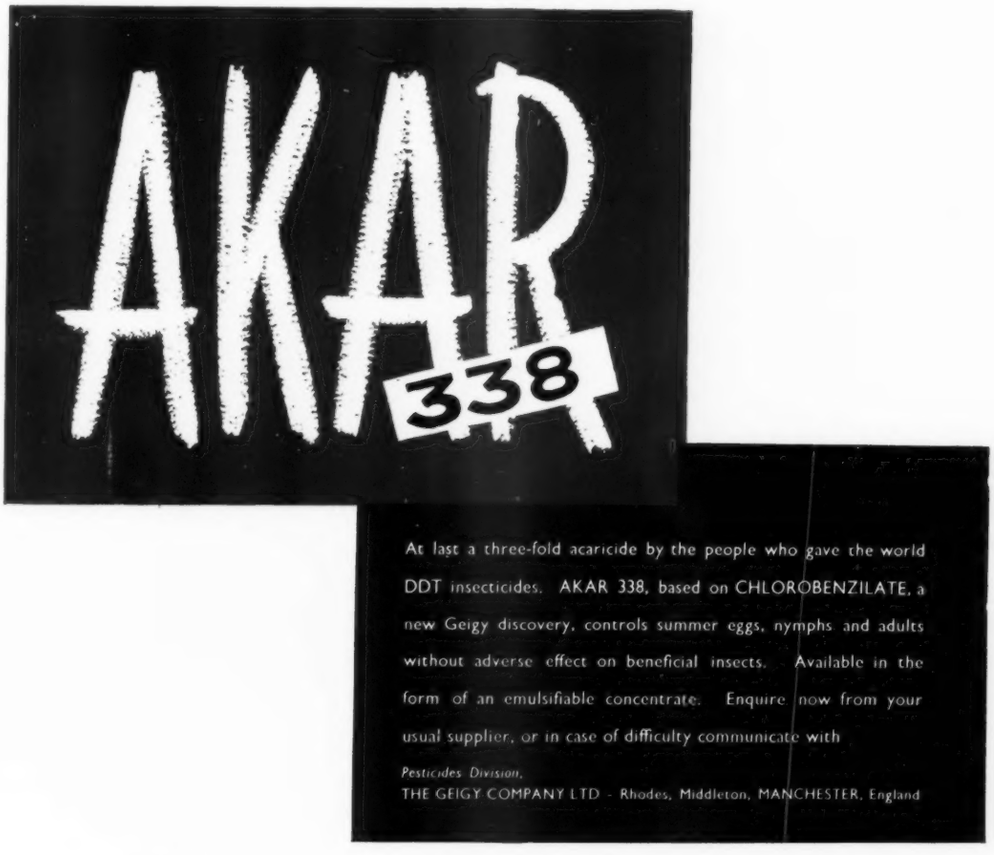
VOLUME 7, No. 6 **JUNE 1955**

A Publication of The Leonard Hill Technical Group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WORLD CROPS

Vol. 7, No. 6

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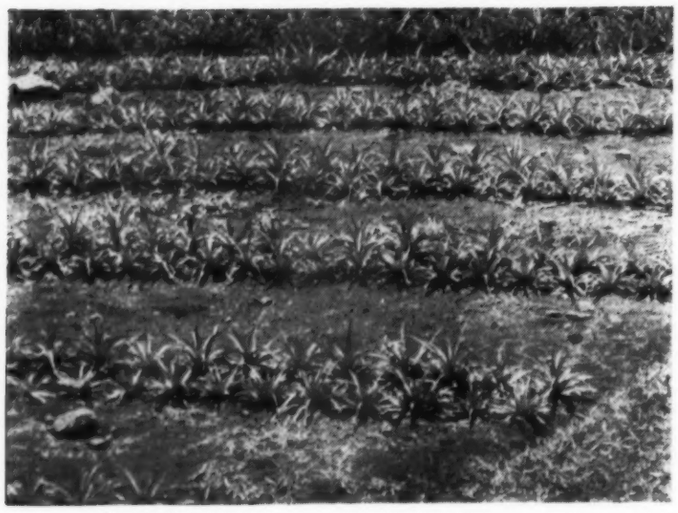

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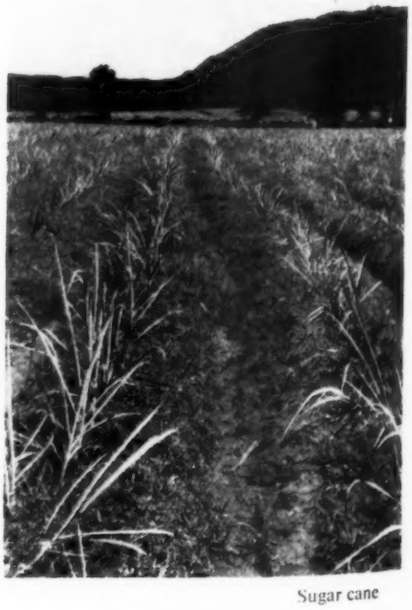

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Editorial Comment

Time for simplicity

IT has been estimated that there are about 80 different selective weedkiller products on the British market; on the world market, there are no doubt considerably more than 80. Here 60 out of the 80, using round figures, are for cereal or grass crops. In a paper presented to the Institute of Corn and Agricultural Merchants Mr. J. D. Fryer of the A.R.C. Unit of Experimental Agronomy gave these figures. When it is reflected that all these products—more particularly the 60 for cereals and grass—are based upon MCPA, 2,4-D or DNOC, it is clear that farmers could be confronted with a considerably smaller range of complexity. Different trade-names often mean no more than variations of formulation. On the other hand, when a company has devoted time and money for both production and utilisation research in developing an effective formulation, it is unreasonable to expect that company to bury its effort beneath a drab cloak of uniformity. Without trade-names or brand names, a good deal of industry's contribution to agricultural research would be discouraged.

The solution is not to displace or belittle the private name that a manufacturer chooses for his product, but to have this commercial method of description accompanied with a statement of composition. That is to say, some (imaginary) selective weedkiller should not be merely labelled ' Culticlean ' with a direction to use at 4 pints per 10 gallons of water, but there should also be a statement that it contains *x* ounces or pounds of 2,4-D, MCPA or DNOC per gallon. Additionally, it would be necessary to differentiate between the salt, amine or ester compounds of MCPA or 2,4-D, but even with this further variation the chance of bewilderment on the farm is reduced from about 60 possibilities to six.

Some manufacturers are already adopting this practice. It will surely be advantageous both to the industry and to farming if their example is universally followed. The fertiliser industry has long accompanied its product and ' house ' names with statements of percentage content; there is, indeed, legal compulsion for this, but it is welcomed by manufacturers as a means of limiting unfair competition. There is, too, another advantage. The extent to which farmers adopt the use of technical products is greatly determined by educational work, by official recommendations and by scientist's lectures and articles. This educational effort is handicapped if it has to be expressed in terms of trade names. Its impartiality becomes suspect; for official advisers, recommendations sometimes become impossible to make at all. Manufacturers who do not describe their products in an alternative way, which enables them to be brought into collective recommendations, are taking their products right out of one of the main streams of progress and increasing use.

Nematodes threaten world food supply

WORMS so tiny that a million of them can live in 1 cu. ft. of soil have become a major menace to agricultural crops throughout the world, reports the current issue of the *Journal of Agricultural and Food Chemistry*. The subterranean villains, which attack plant roots and cause losses of several hundred million dollars a year in the U.S.A. alone, are called nematodes —and their increasingly serious challenge to the world's food supply has precipitated an intensive search for better chemical weapons to combat them, the magazine reports.

Potatoes, carrots, sugar beet, tobacco, cotton, celery, citrus fruits and numerous other key crops are imperilled by the minute pests, which team up with bacteria and fungi in what is often called ' the soil pest complex ' to add to the severity of many plant diseases. Nematode damage is so great in some citrus areas, according to the journal, that the trees of entire orchards have to be pulled out every few years and the orchards started from scratch again.

The journal quotes Dr. Dewey J. Raski, chairman of the department of nematology in the University of California—the State which has the largest agricultural income of any State in the U.S.A.—saying: ' Root-knot nematodes are so widespread in California and attack such a wide range of plants that they probably cause more damage to agricultural crops than any other single disease or pest.'

So far, nematodes have been fought with soil fumigants, which have not proved completely effective, the journal notes. The fumigants must be applied to the soil before planting because of their high toxicity to plants, but researchers are now trying to develop lower-cost products which will not harm perennial plants and will be easier to apply than the fumigating materials.

Damage from nematodes is by no means new and is not restricted to any one area, State or country, observes the journal, which continues: ' It has been said that information accumulated during the past century indicates that all of the world's crops and ornamental plants can be attacked by plant parasitic nematodes. While damage may be mild, it can, and

often does, result in serious or complete loss of crop. Nematologists are careful in estimating the dollar damage to United States crops each year, but there seems to be general agreement that it is at least several hundred million dollars.

'Plant parasitic nematodes have been known since about 1750 . . . Germany and Sweden were among the first to establish nematode control laws. In Ireland, the golden nematode caused such serious losses that laws were passed permitting potatoes on any given plot of land only twice in eight years, with non-host crops in the interim. Similarly, Holland requires two non-host crops between potato plantings. Most European countries now have laws of this kind.

'Nematodes, which may number as many as a million in a cubic foot of soil, are for practical purposes immobile—most move within a radius of only a few feet during their entire lifetime. This means that while the population may increase tremendously in a restricted area, it is slow in spreading unless aided by man . . . Control methods prevent spread and reduce seriousness to a point where there is little economic loss but, as of now, the infestation cannot be eliminated.'

One of the newest nematocides, the journal reports, is a phosphorus product of the Virginia-Carolina Chemical Corpn., Richmond, Va. The agent, named V-C-13 Nemacide, has controlled nematodes without damage to plant roots. It notes that the new product is registered in Virginia and Florida for use on turf and ornamentals and may be offered to treat the soil of citrus and truck crops when it is cleared by the Food and Drug Administration.

The Olin Mathieson Chemical Corpn. of Baltimore and The Stauffer Chemical Co., the Carbide and Carbon Chemicals Co. and the Shell Chemical Corpn. of New York are also active in the field, the journal points out, adding:

'Experimental compounds, including Stauffer's N-869, have given control for living plants without undue injury. Another product of interest in the orchard is Shell's dibromo-chloropropane, a new nematocide previously known as Shell experimental nematocide OS 1897. Satisfactory field tests conducted in various parts of the United States on several crops during 1953 and 1954 showed the most promising and unique property of the material to be its low toxicity to plants and established root systems.

'Carbide and Carbon's experimental dimethyl-thiadiazinethione, a solid, is said to be an excellent fungicide and nematocide. Many other chemical companies are actively working in the field.'

Chemical control has already enabled growers to harvest greater yields than ever before, says the journal, which predicts that 'lower costs and improved application methods will make soil pest control available to new markets, such as the nation's 20,000,000 cotton acres.'

Iowa visit by Soviet farmers

THE *New York Times* has published a short contributed article by Mr. W. M. Blair entitled 'U.S. to let Russians visit Iowa farmers.' It says that Soviet farmers are to have a chance to study the American skills they wish to adopt to grow high-quality corn, hogs and other farm products. The Administration has decided to admit a group of Russian farmers and agricultural specialists for a visit to Iowa, the leading corn-growing and hog-raising State.

Final details are still being decided but it is understood that the State Department will make an announcement soon. These details include the size of the Soviet delegation, the period of its stay and the area it will visit. The decision to admit the farm delegation and 11 editors of Soviet student and youth publications was made at the top level of the Administration. Several informed sources looked upon the decision as forecasting an easier policy on permitting entry of visitors from the Soviet Union and other Iron Curtain countries. The changed policy was viewed as an apparent effort to combat Soviet propaganda on the refusal of the U.S.A. to permit visits on a temporary basis.

The admission of the Soviet farm group was decided upon before the Soviet Union formally asked for the attitude of the U.S. Government on an exchange of agricultural delegations. Informed sources said it was touched off by President Eisenhower's interest. The President received warmly the suggestion by *The Des Moines Register* that the Russians be permitted to visit the heart of the Corn Belt as 'an adventure in human understanding.' The President foresaw only good coming from such a visit by Russians, who are seeking to step up their self-admitted poor farm practices and production.

Indian agricultural labour

THE results of the all-India agricultural labour inquiry conducted by the Ministry of Labour in 1950-51 were published recently. They have revealed that out of 58 million rural families in India, 17.6 millions belong to agricultural labourers. The survey shows that in 1951 30.4 % of rural families were agricultural workers, 22.2 % were landowners and 27.2 % were tenants; the remaining 20.2 % were non-agriculturalists.

The percentage of agricultural families ranged from 77 in North-West India to 84 in Central and West India. The inquiry was carried out in three stages through three different schedules under the headings 'general village,' 'general family' and 'intensive family.' The survey was conducted in 310 villages selected on the principle of stratified random sampling in 27 States and covered 104,000 rural families; its object was to assess general economic conditions and occupational structure in those villages.

The proportion of agricultural labour families was highest in South India, being 50%, and lowest in North-West India (10%). Of the 6.2 million agricultural labour families in the south 5.1 millions lived in Madras State alone. There were five million families in East India, of whom 50% belonged to Bihar. Nearly three million families were in Central India whereas in North-West India there were between one and two millions.

On the age and sex ratio, the report revealed that 52% of the total rural population were males. It also showed that about 54% of the population were in the working-age group, namely 15-55 years, and those under 15 and above 55 accounted for 38 and 8% respectively.

The average size of a holding was 7.5 acres of which 6.6 acres were cultivated. The area owned by cultivators accounted for 4.3 acres (56.8%) and rented land amounted to 3.1 acres (41.3%). The average size of holdings for families of agricultural owners was 11.4 acres; for tenants 7.7 acres and 2.9 acres for agricultural workers. Of the total number of holdings 59% were five acres or less in area; this indicates that scope for employment of hired agricultural labourers was limited.

The report revealed that the problem of housing was acute in rural areas. The majority of houses occupied by rural families are made of mud walls and thatched roofs; they account for about 84% of the total number.

U.S. fertiliser use

TOTAL annual figures for the use of fertilisers in the U.S.A. often give the impression that no country employs these aids to productivity more. In fact, the rate of fertiliser used is considerably below the rates annually employed in a number of European countries; the huge overall tonnage figures of America merely reflect the great size of that country. This needs to be remembered when studying a new U.S.D.A. publication, Agricultural Handbook No. 68, 'Fertiliser Use and Crop Yields'. It is the first attempt to make a nation-wide summary of fertiliser usage and fertiliser-response data, and one of its objects is to show how much more food or cotton or tobacco the existing acreage could produce if it were fully fertilised. The conclusions reached are quite remarkable. Even if a study on so wide a scale can at best provide only broad indications of the potential effects of fertilisers, the amount of room that is still left for raising output per acre is immense. It is so large, of course, because for some major U.S. crops the average rates at which fertilisers are used are still small, very small by Western European standards.

For example, the Southern, North Central and North Eastern States now produce (1950 figures) 2,830,804,000 bushels of corn grain at an average yield of 27-44 bushels per acre; the fullest economic use of fertilisers would nearly double this annual output. Applying test evidence, from plot and farm experiments, to the actual figures of current practice it is shown that a further 2,289,851,000 bushels could be produced from the same acreage, the same seed, and the same cultivation work! The implications are not so dramatic for a crop that is already fairly well supplied with fertiliser on most farms, *e.g.* tobacco. The present output (for the same States as those cited for corn) is 1,994,405,000 lb.; full use of fertilisers would add another 410,780,000 lb. to this total output, an addition of about 20% compared with the potential addition of 80% for corn grain.

Obviously there could be no sudden transformation of this kind—for one reason, the quantity of fertilisers needed would not be quickly producible. It does show, however, that the steadily rising population of the U.S.A. can be fed without decline in nutritional standard so long as the application of modern scientific methods to farming is equally steadily intensified.

Sodium again

THE argument that we should pay more attention to crops' responses to sodium steadily gains in strength. A new and major report has recently emerged in the United States; Dr. W. P. Mortensen, lately of the University of Wisconsin, has reviewed the results of hundreds of plot, greenhouse and field tests on a wide variety of soil types, and the number of crops showing a response to salt dressings substantially exceeded the number showing no response, 22 against nine. This large-scale investigation took place from 1950 to 1954. It represents a more valuable contribution than the former large-scale study by Dr. P. M. Harmer, of Michigan, for in all those U.S. tests of the 'thirties' and early 'forties' only one soil type was involved, a heavy organic soil of market-garden cropping nature (see WORLD CROPS, **2**, 333, 1950). Nevertheless, there is a great deal of common ground in the results of both the Harmer and Mortensen tests; on the whole, it is the same crops that respond to salt and it is the same minority that shows no response.

Sugar beet was, of course, an outstanding crop example, but here further proof by testing was hardly necessary. Dr. Mortensen obtained significant yield increases from 300 lb. of salt per acre for wheat, barley and oats—3.3, 6.2 and 2.4 bushels extra per acre respectively. This confirms the opinion held by some authorities in this country that barley is a good sodium-responsive cereal. Another crop whose sodium requirements are strongly emphasised in the Mortensen report is celery. Indeed, the use of from 300 to 800 lb. of salt per acre for celery is now a standard recommendation from the University of Wisconsin, and commercial growers are reporting better quality as well as increased yields.

In the U.K. during February Mr. M. N. Nicholson of the N.A.A.S. drew the attention of a Conference at Winchester to the importance of salt as a cereal fertiliser. A century ago it was widely used on the chalk uplands of the South, yet there has so far been little investigation of the effects of salt upon modern cereal yields. It is strange that a country with almost unlimited resources of salt should have devoted so meagre an effort to tests of salt as a fertiliser; yet the reports of tests on fertiliser materials that must be imported are now so numerous that no system of filing can hope to keep check upon all of them.

British farm output

AT one time the productivity target for U.K. agriculture was set at '60 plus,' meaning 60% or more above pre-war quantities. Falling world food prices brought in a sudden period of doubt; though perhaps this never achieved the reality of official expression, it was certainly real enough to disturb farming confidence. The widening of the exports/imports payments gap—the actual deficit rose by 70% during five months this last winter—has underlined once more the vital importance of producing all we can from our own resources. It is a pity that 50,000,000 people have to keep on re-learning the same economic law of life, that buying food from abroad whilst soil at home is neglected or under-used is a short-term profligate policy.

The majority of the 50,000,000 are not farmers. They have only the vaguest idea of what has already been done, that the 1954-55 estimate for wheat grain output is 2,790,000 tons compared with a pre-war average of 1,651,000 tons, a rise of 69%; for barley, it is 2,249,000 tons as against a pre-war figure of 765,000 tons, a rise of almost 200%; for potatoes, the estimate is 7,201,000 tons and the pre-war average output was 4,872,000 tons, a rise of 68%; and for sugar beet, 4,623,000 tons are expected to be produced compared with the pre-war quantity of 2,741,000, a rise of 68% again. These are magnificent figures and most branches of industry would be quite unable to match them in pre-war/post-war comparisons!

	Percentage increase in crop output over pre-war average	*Percentage increase in crop acreage over pre-war average*
Wheat	69	32
Barley	194	122
Potatoes ..	68	30
Sugar beet ..	68	30

It is true enough that the arable acreage has risen from about 9,000,000 pre-war acres to some 12,000,000 acres today, but that, after all, is a rise of only 33% and a good deal of the land brought into use must be classed as moderate or even marginal in quality. To emphasise this point, it is worth while comparing the percentage rises in annual crop production with the percentage rises in the acreages now devoted to them. The figures are shown in the Table.

Surplus programmes

THE U.S.A. has sold or given away about $15 hundred million worth of surpluses in the past year, according to statistics prepared by the International Federation of Agricultural Producers. It is currently negotiating to export surpluses worth $400 million. IFAP says, of the total disposal of surpluses owned by the Commodity Credit Corporation, $439 million went for non-commercial sales, intragovernmental transfers, barter and donations. The donations totalled $250 million.

Only a very small portion of the $15 hundred million of surpluses was disposed of under President Eisenhower's new $1,000 million surplus disposal programme. The programme got under way only recently and only a few donations and two sales under his programme are included in the total cited as sold or given away in the past year. Negotiations are being held, however, to sell another $400 million for export under the President's programme. Talks also are in progress for giving away $60 million.

Under Eisenhower's surplus disposal programme, definite sales have been made to Yugoslavia for $60 million and to Turkey for $30 million. Sixty-eight million dollars in surpluses have been given away under this programme. Negotiations are being carried out with Japan for $85 million in sales and $15 million in donations. Talks also are nearing completion for $31 million for Pakistan.

In most of the sales made or being made for disposal of surpluses in the world markets, the U.S.A. is accepting local currencies instead of dollars.

Most of the sales and donations are being made to Western Europe; South-east Asia is next, followed by South America and the Middle East. The programme covers $700 million in surpluses for sale and $300 million for direct gifts. This is to cover three years. The sales are handled by the Department of Agriculture and the Foreign Operations Administration handles the donations. FOA also has another surplus disposal scheme under which it is required to use $350 million for surplus sales.

The U.S. Secretary for Agriculture has suggested that the figure under this programme may be reached in one year instead of three as originally planned. Nearly one-third of the FOA programme has been spent so far. Of the FOA money, 50% has been used for selling cotton, 30% for grains and 15% for fats and oils. Under the President's programme of sales and negotiations so far, the percentages have been 43% for grains, 28% for cotton and 14% for tobacco.

The Kola Nut of West Africa

T. A. RUSSELL

At one time cola used to be shipped to Lagos from the Gold Coast, but this trade has passed more and more into the hands of Sierra Leone producers. Of late years large cola plantations have been made in Southern Nigeria, particularly in the Agege district near Lagos. Much of the West African crop is sliced and dried before shipment to Europe and America, where the prepared cola is ground to a powder and used in the manufacture of certain sparkling beverages. These drinks have a slight stimulating property owing to presence of the drugs caffeine and theobromine which are present in the cola.

EARLY European voyagers to West Africa, in the accounts of their travels, described a seed, variously known as kola nut, goro or guru, which was commonly offered for sale in the markets and was obviously an important article of trade. Later travellers, as they penetrated inland, recounted how they came upon numerous caravans of donkeys, each beast with two large packs filled with the nuts, travelling northwards towards the great markets of Timbuktu, Sokoto and Kano, and beyond them to the desert.

They brought strange tales of the virtues of these seeds. It was said that a man, sustained by a handful of these nuts, could travel for days without water or other food. In the desert these precious nuts had been exchanged for their own weight of gold dust. The Prophet himself had relished the nuts and had made gifts of them to his favourites, so that it had become the custom for his wealthy followers on days of high festival to distribute kola as alms.

To this day the caravans of donkeys plod northwards with their loads of kola, but their efforts are now supplemented by wheeled transport, by the motor lorry and the railway train. The characteristic hampers or ' blies ' containing kola nuts are to be seen waiting railment at every station in the western region of Nigeria, and almost daily a loaded train carries them north to Kano. We may well ask, as did the early travellers, ' What is this kola which is so greatly valued in so large a part of Africa?'

Kola plantings cover a wide area of Western Nigeria

The source of kola

A description of the kola nut, made by a Portuguese traveller in 1593, likened it to a chestnut, but splitting into four parts, of a red or pink colour, which, being eaten, appeased thirst and strengthened the stomach. The tree on which it grew was not described and it was not until 1805 that there was published by Palisot de Beauvois an account of the kola tree seen by him near Benin, which he named *Sterculia acuminata*. This, with some other species, was later transferred to the new genus *Cola*. In a letter written from Fernando Po in 1859, the explorer Barter pointed out that there were two kinds of kola nuts, one of which came from a tree seen by him on that island and beside the Niger, the other grown, according to his informants, in Ashanti. In later work by German botanists, and in the valuable monograph by Chevalier and Perrot, several species of *Cola* supplying edible seeds were described.

Cola is a genus of the family Sterculiaceae and is therefore a member of the same family as cacao. The species of *Cola* with edible seeds are mostly larger and more robust trees than cacao, and if we were to seek for a common tree with which to compare it we might liken it to a horse-chestnut in stature, but with entire, shining, leathery leaves such as are familiar to us in the cherry-laurel. The fruit is unlike that of cacao, being borne on the young branches and consisting of a ' hand ' or star-shaped group of ' pods ' or follicles, usually about five in number. The follicle contains several succulent seeds each about the size of a large chestnut. The seed, although miscalled a nut, more nearly resembles

Harvesting of kola is spread over several months of the year

a bean and is largely made up of the cotyledons. In the chief kola of commerce these are two in number, so that the seed readily splits into two almost equal pieces. Other edible kolas are remarkable in having a greater number of cotyledons, often four and sometimes as many as six, and these seeds divide into a corresponding number of pieces when split.

The most valued kola

The kola of popular trade is *Cola nitida* (Vent) Schott and Endl., whose home is in the forests of West Africa from Sierra Leone eastwards as far as the Gold Coast. This is the kola which, from remote times, has been carried northwards from the coastal areas of production to the great consuming area of the Sudan region in its widest sense, the Mohammedan country south of the desert and stretching right across Africa. This kola is now extensively cultivated in its native lands and in the last 50 years it has been planted over a large area in Western Nigeria outside the range of its natural occurrence. The extent of this planting in Nigeria may be gauged from the weight of kola —between 50,000 and 60,000 tons— now carried annually on the railway line which runs between Lagos and Kano, and, if we make allowance for the unmeasured quantities transported by other means or consumed in the producing area, it seems likely that Nigeria's production approaches 100,000 tons. Official figures from the French territory of the Ivory Coast give the number of trees planted there as nearly 8½ millions, from which an annual production of about 30,000 tons of nuts may be expected. No recent estimates of production from the long-established plantings of Sierra Leone, Liberia and the Gold Coast have been seen, but their tonnage, added to the calculated production of Nigeria and the Ivory Coast, would doubtless reach a formidable total. The tree has been carried to other lands, to South and Central America, the West Indies, Mauritius, Ceylon and Malaya, but, apart from some plantations in Brazil, it has not been grown on a large scale outside West Africa.

The other species of *Cola* with edible seeds are of secondary importance or have a more local use. Amongst these is *Cola acuminata*, the species native of Nigeria which was seen by Palisot de Beauvois and by Barter. This is the kola most highly regarded by the Yoruba people of Western Nigeria and preferred by them for their social and religious customs.

The cultivation of kola

Cola nitida grows under much the same climatic conditions as cacao, but is less exacting in its soil requirements. Thus in Western Nigeria, while kola does well in the clay loams to which cacao is restricted, it will thrive also in soils of a lighter texture so long as these possess good depth and drainage.

A journey inland from the port of Lagos in the south-west corner of Nigeria provides the observant traveller with a clear picture of the conditions suited to kola. In the waterlogged land intersected by creeks near the coast the tree is absent, but it begins to be seen as the land rises and becomes better drained. In the light loams of good depth in the area known as the Colony the road runs for many miles through thickly planted kola, forming groves or woodlands of dark, evergreen trees. Later, in an area of dry and shallow soil, kola disappears, but it reappears as the soil becomes deeper and with a higher clay content where kola trees are found planted here and there through the cacao farms. Only when the forest zone gives way to grassy savanna country does kola finally disappear.

When preparing to plant kola the farmer commonly clears the ground by slashing and burning the bush growth and trees, though sometimes he will leave unharmed occasional trees, such as oil palms, which he values. He then scrapes the soil into ' hills,' on which he plants food crops, maize, yams and cassava. Kola seed is buried between these at suitable spacing, usually from 20 to 27 ft. apart. The food plants provide a temporary shade for the kola seedlings.

In some parts of West Africa seed of kola is never sown because it is believed that the man who plants the seed will surely die as soon as the young tree comes into flower. Instead a search is made for self-sown seedlings and these are carefully transplanted and are grown, apparently without the same deterrent. This belief, however, is not generally held throughout West Africa. The Nigerian farmer has no scruples about sowing kola seed and elsewhere, indeed, seed may be sown to mark a special occasion. It is recorded from an area to the south of the French Sudan that, as soon as a child is safely delivered, the umbilical cord is put in the ground along with a kola seed. The tree which results, and any seedlings which germinate under it, become the property of the child as he grows up.

The seed of kola takes some weeks to germinate and is vulnerable to attack

by numerous pests as well as to drought over a prolonged period. Rather slow growth continues to be made by the plant in its early years. The only cultivation attempted is the occasional weeding which the farmer gives in tilling the interplanted food crops. These are abandoned after a few years as the kola begins to shade the ground, and thereafter the only work done is a periodic slashing of the undergrowth to enable fallen fruit to be easily seen. The kola may flower from the fifth year, but fruit is not usually produced until about the seventh, and then only scantily. By the twelfth or fifteenth year after planting a fair crop should be won and the tree is considered to be in full production from the age of 20 years. Trees are long-lived and may well continue bearing until 70 or 100 years old.

The skinned nuts are closely examined and graded for size and colour

The kola harvest

In harvesting the fruit a long pole bearing a curved knife blade at the tip is used. Armed with this, a good climber is sent up the tree to clamber about and knock down all the fruit seen to be ripening. This should be done monthly during the period from September to January, when most of the fruit is ripened, and in some years a few fruits may mature also in June and July. The pods which have fallen to the ground are picked up and are usually split on the farm, the seeds being extracted and carried to the village for treatment.

At this stage the seeds are covered with a tough white skin, and the first process is to remove this coat, usually by 'sweating' the seed in heaps, followed by washing and gentle drying. The nuts are then packed in baskets lined with large green leaves, which are replaced by fresh ones from time to time. If stored in a cool place, kola nuts thus treated may be kept for many months without spoiling or losing their freshness.

Much of the kola is bought by traders, who are Hausas from the north and come to the distant kola farms to engage in this trade. On acquiring the nuts their first act is to examine them one by one to make sure that any infested with the much feared kola weevil are removed, and to grade the sound nuts according to size and colour. The nuts are then packed into a special wrapping, the 'bly,' which, with its inner packing of green leaves and its outer coat of hessian secured by native rope, is designed to keep the precious contents both fresh and undamaged during their journey to the north. The building of this container round the kola nuts is done by skilled labourers with admirable speed and dexterity. A tradition originating in Bornu insists, moreover, that they be men of good character, since nuts handled by persons who possess the evil eye or are dishonest or slovenly by nature are certain not to keep well.

For transport to the north kola nuts are packed in containers lined with fresh green leaves

The problem of low yields

Records from Nigerian trees indicate that the annual yield of a farmer's planting of kola commonly averages about 210 saleable nuts per tree or roughly 525 lb. per acre. Similar figures have been published in the Gold Coast from plantings made by the Department of Agriculture, although here, it may be noted, the trees

had not reached the age of full production when these yields were recorded. In both places there was apparent a very marked variation in yields of individual trees in a plantation. In one Nigerian kola farm, which is probably typical of many, it was found that a few trees were giving very high yields, producing seven times or even 10 times the mean yield per tree over the whole plot. Nearly 72% of the crop over a period of four years came from 21% of the trees, or, in other words, four out of five trees were giving little return at all.

The unproductiveness of his trees is a matter of concern to the Nigerian kola farmer, and his common practice is to slash the trunk with his machete in the belief that this will cause the tree to become more fruitful. This was put to the test in an experiment in the field and evidence was obtained that such wounding of the bark may indeed be effective in increasing significantly the yield of mature fruits.

The seed, after removal of the seed coat (the kola nut of trade), is most commonly red in colour, but may be white or of varying shades of pink. It is possible to find nuts of these different colours on the one tree, and even in the same fruit. Occasionally, indeed, a nut appears in which one cotyledon is pink or white and the other red. This apparently erratic occurrence of colour in the seeds has caused much perplexity and was only explained by the work of Voelcker published in 1935. He showed that the colour was an inherited character and that, since the kola nut was mainly composed of the cotyledons or first leaves of the new seedling, its shade depended upon the factors for colour conveyed by both male and female parents. Thus seeds on the one tree could have different cotyledon colour if the pollen by which they were fertilised came from trees differing in this character.

Uses of kola

The chewing of kola is general and habitual throughout West Africa and the Sudan region. Its use has been likened to the cigarette smoking of Western countries. The traveller setting out on his journey lays in a supply for his comfort and sustenance on the way. The lorry driver will almost certainly carry a few nuts to cheer the long road, and the clerk will not forget to have two or three on his desk or in his pocket so that he may keep alert and clear-minded at his work. For kola acts like a cup of coffee. It is a stimulant containing caffeine and theobromine. As an early writer wrote, the seed of kola, 'as experience teacheth, eaten in the evening, hindereth sleep.'

Kola also enables the user to make strenuous physical effort without undue fatigue. In 1890 the British Consul at Bahia in Brazil drew attention to 'the great powers of endurance and strength in lifting heavy loads and transporting them to long distances in this climate possessed by the West African negroes in these parts, which personal observation and conversation with them enable me to attribute to the free use of the kola bear. The African, through constantly masticating kola, can endure labour and fatigue which no Brazilian carrier can withstand, and where, for instance, it takes eight Brazilian negroes to carry a load with difficulty, four African porters carry it cheerfully, almost always, even though ascending a hill, singing and chanting the whole time as they trudge along, but never without a bit of kola bean in their mouths.'

In addition to its everyday use, however, kola has many special usages and attributes. In Yoruba country an offering of kola is made as a welcome to the honoured guest. White or pale pink nuts are preferred for this purpose and if the more common red ones have to be proffered the gift is sometimes accompanied by such an expression as 'If I had my will, these would be white.'

The gift of kola, and especially white kola, signifies peace, friendship and sympathy amongst those partaking. Thus at the signing of a contract or the making of an alliance between two parties a kola nut may be split and eaten. At a betrothal ceremony, and again at a wedding amongst the Yoruba people, the distribution of kola is an important part of the proceedings and the sharing of the nuts amongst the people present signifies their approval of the union and their good wishes for its fruitfulness. On less peaceful occasions confederates, binding themselves to summary action by an oath of secrecy and loyalty to each other, would confirm this by splitting a kola nut into bits, of which each man ate a piece.

Besides its use in the social customs of the people, kola has its place in religious practices. For what could win the favour of the pagan god more readily than a gift of large kola nuts? It is also employed to interpret the mind of the god in divination. The priest, after tossing pieces of kola on the ground and noting how they lie, will tell the supplicants whether the god is angry or appeased, whether the tardy rains are longer to be withheld, whether or not the stricken man will walk again.

The future of kola

Despite its unique place in the life of West Africa and the large volume of internal trade in this product, kola has received little attention from the agricultural scientist. Its development has been almost entirely at the hands of native farmers and traders, whereas the plant breeders and agronomists, occupied with the cacao and oil palm, the cotton and groundnuts required for Western markets, have had little time to spare for kola.

Nevertheless, this tree crop would well repay some scientific study. The yield figures which have been quoted, showing the great variation in yield of individual trees, suggest that planting material might be much improved by a process of selection. If four out of five trees in the normal farmer's planting are unproductive, then a planting in which every tree is a fruitful one will give greatly enhanced yield and profit. A first step, therefore, is to record the performance of individual trees over a period of a few years and to pick trees which are outstanding in respect of yield, size and quality of nuts for use as the parent trees for new planting.

The extent to which vegetative propagation of these chosen trees can be used calls for study. While stem cuttings can be rooted with some degree of success, it is not yet known if the growth and production of trees raised from cuttings are as satisfactory as those of seedlings.

An investigation into the causes of the low yield of so many kola trees might well bear fruitful results. More information is needed about the pollination and fertilisation of the flowers.

While some kola trees are self-fertile, it seems likely that others are self-incompatible and that pollen from another tree must be brought to the flowers if any fruit is to be set. Perhaps a form of incompatibility lies behind the unproductiveness of some trees.

Along with the use of selected planting material, improvements might be made in the establishment and cultivation of the crop. If valuable seed is to be used, the farmer's method of sowing in the field, with its frequently heavy loss of seed, must be changed. A safer method, though calling for more expenditure of effort, is the starting of seed in baskets of soil in a nursery. The germinating seed can here be protected against pests and, when the seedlings have made a good start and have passed their most vulnerable stage, the baskets are planted out at suitable spacing in the field.

Potentialities

As, therefore, there seem many ways in which the production of kola may be improved, it is necessary before advancing too far along them to study the outlets for the product and make sure that there is a market for the greater production which might ensue. In recent years in Southern Nigeria, although kola prices have not been unduly high, the growers appear to have experienced little difficulty in disposing of good-sized nuts. It is not known whether or not the African market is capable of expansion or, indeed, what is the final destination of many of the nuts, and research into the distribution and consumption of kola might give results of interest and value.

At one time the German colonists in West Africa were keenly alive to the possibilities of kola and had great hopes of developing a profitable trade with Europe. This trade, though it never attained any great size, is nevertheless not quite extinct. A type of chocolate containing kola is still made in Germany.

Recalling the valuable properties of kola and the manifold uses to which it lends itself in its native continent, one feels inclined to ask if its potentialities have indeed been sufficiently explored by our food chemists and if there may not yet be opened up a wider market for this imperfectly known product of West Africa.

The kola, firmly packed, is brought to the railway station for loading on the ' kola special,' a fast goods train to the north

' You Versus Pests ' Exhibition

An exhibition, ' You Versus Pests,' promoted by the Royal Sanitary Institute in conjunction with the Ministry of Agriculture and Fisheries, was opened recently by the Rt. Hon. D. Heathcoat Amory, M.P., Minister of Agriculture and Fisheries and of Food. A statement by FAO, displayed at the exhibition, said that world loss of bread-grains and rice through pests in 1947 was about 33 million tons, almost equal to the total amount of food moving in world trade. It would feed 150 million people for a year, said the announcement, which added soberly: ' World grain supplies are lower than in 1938, but the population has increased since then by 200 million.'

On display were some thousands of important insects, including a variety of live specimens, which cause immense damage both to the nation's large imports of stored food and to health. Many of the insects shown were kept alive by the most up-to-date scientific methods, which necessitated elaborate feeding arrangements.

Apart from showing the insects at work and the resultant damage to the country's food supplies and health, the exhibition also indicated some of the most successful methods of prevention and control. In addition, there was a pictorial account of the steps being taken by the Ministry of Agriculture (Infestation Control Division) to inspect all imported stored goods, not only on their arrival in the U.K., but during their transit and storage here.

It was emphasised that, whether dealing with bulk storage in factories or food in the home, cleanliness still continues to be the most important weapon in preventing attacks by insects.

NIAB Recommended Lists

The National Institute of Agricultural Botany has just published its Recommended Lists for Spring Wheats, Barleys and Oats for 1955, in the latest editions of the well-known ' Farmers' Leaflets ' Nos. 2 and 13. No new varieties have been added to the lists this year, but a number of varieties superseded by the newer types have disappeared in accordance with the preliminary notice given 12 months' ago. The institute now recommends four spring wheats, 11 spring barleys and nine spring oats. The ' Farmers' Leaflets ' give the usual notes on each variety, and a summary of their main characters in tabular form. The revised ' Farmers' Leaflets,' incorporating the Recommended Lists of Winter Cereals for Autumn 1955 were published during May.

Cider-Apple Growing in the United Kingdom

E. R. WEBBER

The manufacture of cider is now an important industry in the United Kingdom. Present-day production is in the region of 20 million gallons compared with an estimated 100 millions in 1901, but the former figure does not include the still fairly considerable quantities made by farmers and growers as distinct from the cider factories. From 1916-23 the commercial annual production fell to an average of six million gallons per year, and at the beginning of the last war had increased to about 15 millions.

CIDER making is one of the oldest English industries, having been made in England since Saxon times. It has been claimed that cider was known to the Hebrew and African races but there is no definite evidence for its use until the second and third centuries A.D., when it is mentioned in early Roman histories.

In Pliny's ' Natural History,' drinks made from apples and pears are spoken of, and both Tertullian and St. Augustine record that the Manichees drank liquors made from fruits and which were superior to wines. At the end of the fourth century St. Jerome uses the word ' *sicera*,' from which the modern word ' cider ' is derived. From the books of Strabo it is clear that apples and pears were widely cultivated in Gaul and that these two fruits were used to make several beverages.

Cider was being made on a fairly large scale in Norfolk in the 13th century, and these early records also mention Yorkshire as a centre of production. It is probable that at one time cider making was more or less generally distributed throughout the U.K. wherever apples were grown.

At the time of the Norman invasion, France was already an important cider country and it is very likely that many of the French varieties of apples were introduced to England at this time.

In more recent times there was a considerable boom in cider drinking during the Napoleonic Wars as French wines were no longer obtainable. It was during this period that the planting of cider apples was carried out on a large scale in the west of England, and this laid the foundations for the later extensive cider-making industry in these parts.

This area extends from Hereford and Worcester in the north, southward along the course of the Severn to the Bristol Channel, taking in the counties bordering the Channel on its English side. Hereford, Worcester, Gloucester, Monmouth, Somerset and Devon constitute the centre of present-day cider-apple production, and adjacent districts in some of the neighbouring counties of Shropshire, Radnor, Wiltshire, Dorset and Cornwall also contribute on a smaller scale.

Outside this region, Norfolk still remains a centre of production and one of the largest cider factories in the country is located there. Kent was once well known for its cider and there are signs of a revival in that county.

In other parts of the U.K. production is small, although Ireland possesses several quite important cider-making centres. The Channel Islands, Jersey in particular, produce small quantities of cider.

Cider production in the U.K. is particularly associated with those areas in which grass orchards predominate. In 1951 the Orchard Fruit Census gave the acreage of cider-fruit orchards in the main centres of production as approximately 46,600. These, although chiefly apple, do contain a certain amount of perry pear trees.

Much of the fruit grown in this way is, however, unsuitable for the modern methods of cider manufacture. To

Typical farm orchard, Hele, Devonshire

enable the manufacturer to produce various uniform grades of high quality cider the following requirements are necessary in the fruit supplied to him.

Types of cider apple

Balanced quantities of each of the three main classes of apple—'Sharp,' 'Sweet' and 'Bittersweet'—are necessary in order to produce a suitably blended cider. The Sharp class can be replaced by the 'cull' fruit of the commercial grower of market apples but the Sweets and Bittersweets must be grown specially.

The fruit must be of known character and quality. This is difficult with the fruit from the older-type farm orchard which often contains a large selection of varieties, many of them grown from local seedlings. Modern plantations and orchards are restricted to a few known varieties.

Regular supplies over a period of several months are required by the large cider manufacturers in order to avoid congestion and the duplication of machinery.

Present-day position

The growing popularity of cider has awakened a new interest in farm orchards, which, in many counties, had begun to disappear. Many of those which are left are, however, almost worn out and this, together with the failure to plant new orchards during the last 50 years, has led to a shortage of good-quality home-grown cider fruit at the present time. It is estimated that the present acreage of farm orchards in the west of England is only about 40% of the acreage of 60 years ago and in recent years it has often been necessary to import cider from France in order to meet the home demand.

To improve this position many of the large cider manufacturers have planted large acreages of farm orchards for their own use and have made available young trees for sale at a moderate price to farmers and others who may be interested.

The National Fruit and Cider Institute at Long Ashton—now attached to Bristol University—was formed in 1903 to undertake scientific research. During the last 50 years this establishment has carried out scientific investigations into both cider-apple growing and cider manufacture. Its findings have been of immense value to the whole industry.

A group of 60,000-gal. storage vats

Soil and climate

Site, soil and climate are three important factors in the growing of cider fruit; not only do they govern the growing of healthy and fruitful trees but they have an important effect on the vintage quality of the fruit. Apples grown in full sun develop more fully in chemical composition as well as in physical character than those grown under shady conditions and the resulting ciders show this difference. For this reason a slope with a south-easterly aspect and somewhat sheltered from the wind is to be preferred as a site.

The trees may be grown in a wide range of soils with the main exceptions being chalk soils and very shallow soils. Good drainage is important as healthy trees cannot be produced under conditions of intermittent water-logging. The type of soil also seems to effect the quality of the cider derived from the apples grown on that particular soil. Light gravelly and sandy soils, for instance, yield ciders of a lighter or harder quality than those obtained from fruit grown on heavier loams.

Cider-apple growing is mainly carried out in a region comprised of those western counties which have an annual rainfall of 35 in. and upwards, and a summer temperature generally lower than in the south-eastern and eastern districts where dessert apples comprise the main crop.

A high summer rainfall seems to be an advantage as most of the best vintage ciders have been produced from crops grown in seasons when periods of sunshine were accompanied by a fair amount of rain during late summer and early autumn. Under dry sunny conditions the sugar content of the cider is usually very high, making the cider richer and more 'full-bodied' but lacking the finer qualities of apple flavour. With a cold, wet, sunless season the resultant cider may be thin and lack alcoholic strength.

Cultivation

Local conditions may decide the type of tree to be grown. In most areas standard trees with trunks not less than 6½ ft. to the lowest branches are grown so that the head of the tree is not liable to damage from grazing animals. In certain windswept districts and on steeply sloping sites, shorter trees are often preferred but when these are used grazing has to be restricted to sheep and young stock. In recent years the bush tree plantation has been successfully applied as an alternative to the standard tree orchard.

The possibilities of the bush tree plantation have been demonstrated in a series of trials established in 1937 by the Long Ashton Research Station at

Modern hydraulic cider presses operate at 2,500 lb./sq. in. pressure

various centres in the west of England and in Kent. These trials have shown that on good land and under efficient management some varieties are capable of giving yields varying from 5-10 tons/acre by the tenth year. The culture is very similar to that practised in commercial plantations of dessert and culinary apples and this system shows promise of giving quicker and better returns than the older farm orchard system.

With bush trees the harvesting of the apples and the control of pests and diseases can be carried out more economically and more efficiently. The best length of tree stem is about 3 ft. and two-year-old trees or one-year maidens can be planted. Square planting is recommended with a spacing of not less than 36 ft. or the trees may be planted in a rectangle with a row spacing of 36 ft. and the trees 18 ft. apart in the rows. With the last method alternate trees may be removed later or all of them may be retained and pruned in such a way as to form ultimately a kind of hedge. The hedge system is particularly suitable for automatic spraying but it must be regarded as still being in the experimental stage.

For the farm orchard and its standard trees the age of tree for planting is generally about four years, although there is still much controversy as to the most suitable age and in some places trees of seven to eight years are preferred.

Three classes of rootstock may be used—crab, free and layered.

Crab rootstocks are raised from crab-apple seed or from layered stock, and free rootstocks from apple seed obtained from the pressed pomace of cider apples. Layered rootstocks are raised in stoolbeds from selected clonal rootstocks of known character. The crab rootstocks were formerly used extensively and recently have shown signs of regaining popularity. The chief disadvantage with these and with the free type is that they come from many varieties of apple and therefore lack uniformity. Layered rootstocks will give uniformity if the same type is used consistently.

In order to speed up the growth of young trees the practice of double-working is being adopted on an increasing scale. The rootstock is first budded or grafted with a suitable strong-growing variety and, after a good stem has been formed, it is top-grafted with the selected variety. This final grafting can be done either in the nursery or in the orchard after planting.

Choice of variety

When a new orchard is to be planted it has to be decided what class or classes of apple should be grown. In the Sharp class are found all varieties with juice acidity normally above 0.45% irrespective of the tannin content; in the Sweet class, acidity content is normally below 0.45% and tannin does not normally exceed 0.18%; the acidity of the Bittersweet class is normally below 0.45% but the tannin content usually exceeds 0.18%. This classification has also been sub-divided giving mild, medium and full divisions.

What is known as vintage quality in an apple is a combination of characters that determines the nature of the cider made from that single variety of apple. The degree of such quality is decided primarily by the chemical composition of the juice.

Not all good vintage apples, however, will produce a suitable cider if only the one variety is used. The famous Kingston Black will, in favourable seasons and on good soils, produce, without blending, a cider of excellent quality but most other varieties require to be blended in order to give the desired qualities.

A suitable variety of apple for planting should possess a vintage quality and at the same time be a good orchard tree. To help new growers the Cider Advisory Committee of the Long Ashton Research Station in consultation with the Orcharding Sub-Committee and Cider Research staff issued, some years ago, a list of recommended varieties. This list was drawn up to direct attention to a limited number of varieties of proved merit as a first step towards the improvement and standardisation of home-grown fruit for the cider industry and so to provide in due course the best possible raw material. The list is now in process of revision.

A limited number of varieties is necessary to the cider manufacturer so that standardised blends of cider can be ensured. The list is divided into two sections; varieties for general planting and varieties for local planting. Those for general planting have already been tested over a wide area; the trial for those for local planting has not been so extensive but they have all been found successful in the areas named. In each section the varieties are placed in their appropriate vintage class and according to the ripening season for cider making.

The varieties for general planting are:

Sweet: Court Royal, Sweet Alford, Sweet Coppin.

Bittersweet: Bulmer's Norman, Tremlett's Bitter, Yarlington Mill,

Ashton Brown Jersey, Dabinett, Tardive Forestier.

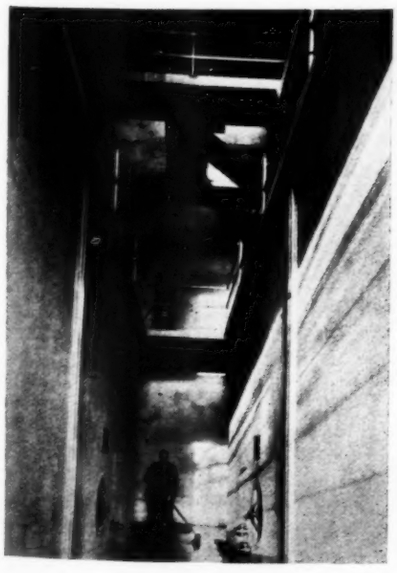
Bittersharp: Improved Foxwhelp, Kingston Black, Stoke Red.

Sharp: Backwell Red, Crimson King.

The immediate need of the industry is for more fruit of the Sweet and Bittersweet classes, particularly the Bittersweet. As a short-term policy, new plantings could with advantage be confined to these classes. The Sharp class is in least demand as most of the requirements of the manufacturers in this direction can be met from the unmarketable cull fruit of the commercial grower of dessert and culinary varieties.

It must also be decided whether fruit will be grown for the whole of the cider-making season or for a part of it only. At present the bulk of the fruit supply is of the mid-season ripening period which means that the factories often have to operate during the early part of the season with windfall fruit. There is also a shortage of home-grown late varieties.

Whatever class or classes are grown it is essential to avoid the indiscriminate mixing of varieties which ripen at different times. It should be arranged that the varieties can easily be kept separate at harvest time. No single variety, however, should be planted on its own in large blocks as this may lead to trouble with pollination. An arrangement of trees in blocks of four or five rows interspersed with corresponding blocks of another variety is better.



A cider tankhouse with plastic-lined concrete vats, Hele, Devonshire

Apple orchards, Hele, Devonshire

For the standard apples, row spacing of 36 ft. is necessary if the tree is to be allowed to reach its full size and some of the stronger-growing varieties such as Bulmer's Norman require up to 40 ft. Weak-growing varieties such as Dabinett can be spaced at 30 ft.

Planting is carried out during the winter months when soil conditions are suitable and the young plants should be securely staked and protected by a guard of wire netting. For the first two or three years after planting the soil round each tree is usually kept free from weeds and during this period a mulch of farmyard manure is generally applied. The newly-planted trees are generally pruned in the winter following that of planting. Crowded shoots are removed and leading shoots shortened to between one-third and one-half of their length according to the vigour and strength of the variety.

Pruning is continued until the head of the young tree has been satisfactorily shaped but, after this, little pruning is required except for the removal of damaged and intercrossing branches.

Tree nutrition

Cider-apple growing has always been associated with grass orchards and the grazing of livestock. The fruit from trees grown in grass have a lower nitrogen content and a higher sugar content than fruit from cultivated ground. This makes the fermentation of the juice more manageable and produces a better cider of a higher alcoholic content. Also in grass orchards the apples are not so badly bruised when they fall off the trees and the fallen fruit remains comparatively clean.

The nutrition of the trees in established grass orchards needs close attention in respect of nitrogen, potassium and magnesium and the need for phosphorus in relation to grazing must be taken into consideration. Farmyard manure should be used with care as too much tends to lower the vintage quality of the fruit as well as to increase the susceptibility of the tree to Apple Scab.

Control of diseases and pests

Regular spraying is necessary if pests and diseases are to be kept down. Besides the normal enemies of apple trees, cider orchards are liable to attack from the serious Armillaria Root Rot disease which is caused by the Honey Fungus (*Armillaria mellea*). This destructive disease spreads through the soil and attacks the roots and collar region of the tree. An infected tree has the external tissues of the wood at the base of the tree permeated with white cotton-like bands of mycelium. This stage of attack is usually followed

in the summer or autumn by the appearance of clusters of brownish toadstools at the base of the tree.

Trees of all ages are attacked and no simple method of control is known. It can often be restricted by digging a 2-ft.-deep trench around the affected tree but with young trees it is better to remove the infected tree altogether at the first sign of trouble and the land left unplanted for at least three to four years. The disease does not only attack living trees but is found on old roots and stumps in the soil. Stumps should never be allowed to remain as a source of infection.

As the financial return for cider apples is not high when compared with market crops, the amount of money to be spent on spraying has to be restricted, but as much as possible should be done.

It is difficult to spray the usual type of standard tree effectively and there is always a fair amount of unavoidable waste of spray material. The hand-operated lance with a high output is probably the most effective method of application but, on a large scale automatic sprayers have been very satisfactory. The quantity of spray required by standard trees varies considerably. A 50-year-old orchard containing 40 standard trees to the acre will need 700-1,200 gal. of a winter spray per acre to give a satisfactory coverage. A three-man spraying team should be capable of spraying 1,500-2,000 gal. on a favourable day.

Harvesting and marketing

The harvesting of the fruit has an important bearing on the subsequent cider. Some loss of vintage quality will take place unless all the apples are heaped in approximately the same condition of ripeness. Heaps of different varieties should be kept separate if possible and windfall apples should not be mixed with those shaken from the branches.

Hand-picking is never done and the usual method is to shake the branches lightly so that the ripe apples fall to the ground. The windfalls should be gathered and heaped before this is done. The shaking of the branches is best carried out at regular intervals and the apples from each tree collected into a heap under the particular tree.

The apples are mostly bought direct from the growers by the cider manufacturers either at their central offices or through buying agents. Manufacturers prefer that apples which mature at different times should be kept separate but the produce of many small mixed orchards is frequently bagged without regard to kind or maturity. In some cases a price premium is paid for named sorts which have been bagged separately, and sometimes also for fruit delivered after the first week in November. This latter premium encourages the segregation of the later fruit. The sacks are usually provided by the buyers and are often second-hand sugar sacks, which hold about 1 cwt. of apples.

Thus it would seem that the advance in the general popularity of cider should make the growing of cider fruit more profitable and, in fact, there is already an awakened interest in farm orchards and in the newer bush plantations. There is at present a shortage of suitable cider apples and though prices are not high, it seems likely that they will be maintained at a fair level for some years at least.

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Photos: Whiteways Cyder Co. Ltd.; H. P. Bulmer & Co. Ltd.

Sisal Treatment in Tanganyika

Two modern and interesting installations have recently been erected in Tanganyika. These are the first installations built for a new system of drying, transporting and baling the sisal, developed by Mr. J. H. Zimmermann from the Netherlands, who is now residing in East Africa. The system is covered by several patents in various sisal-growing countries. It is very suitable for other long hard-fibres also.

The feature of the new system is that the sisal, after being washed and dehydrated in a centrifuge, is formed into layers of equal size and weight. The dimensions of these layers correspond with the dimensions of the press in which they will be pressed into bales at the end of the process. Each layer is gripped in a clamp of special design and the clamps are placed on trolleys, from which the sisal strands hang loosely downward in a straight and parallel position. The trolleys can be moved along an overhead mono-rail through the factory. Three of these trolleys can take the quantity of sisal necessary for the formation of one bale. The mono-rail leads the trolleys to a drying compartment. Hot air is blown in an upward direction through the fibre mass. Practice has already proved that this is by far the most economical way of mechanical drying.

Battery of centrifuges

After the drying the trolleys are moved into a reconditioning compartment and then, passing a weighing-bridge in the mono-rail where the weight is controlled and adjusted if necessary, they are moved to the baling press.

Since the layers are an exact fit in the box of the baling press, the formation of the bale becomes a very simple matter. The clamps with sisal are lifted from the trolleys and pulled into the bale box and when the layer of sisal is in its correct place in the bale box the clamp is removed. The bales so produced are of excellent shape and quality.

By this system the mechanisation of sisal production has come an important step forward. Brushing of the fibre, which is the most unpleasant and expensive part of sisal processing, has been completely abolished. The losses in waste and tow have been reduced to the minimum.

A Future for Oil-Based Sprays?

E. J. BALS and G. J. ROSE

Micron Sprayers Limited

The use of oil-based sprays is of recent origin and there is need for much work by manufacturers and researchers before their real value can be assessed. However, results of trials made in various countries have suggested that oil-based insecticides and fungicides may offer a method of overcoming the evaporation factor, which has restricted the adoption of the low-volume technique in many territories.

THE adoption of a low-volume-spraying technique when possible has been recognised to have many advantages over high-volume spraying. A large proportion of the cereal weed spraying with the hormone weed-killers is now carried out using low-volume-spraying equipment. Applying an insecticide or fungicide with a low-volume sprayer means that large areas can be treated very quickly with small demands upon labour. The degree of protection is often increased owing to the fact that all the crop can be protected at the most appropriate time. The elimination of the need for using over 90% of the water required for high-volume spraying reduces the cost of water transport and spraying can take place in regions where it might otherwise be impossible. At times it has been shown that by using a low-volume technique on such crops as orchard fruits or coffee quite large savings in the actual amount of active chemical required per acre can be achieved.

Limitations

There are certain limits imposed by this technique, one of the more important of these being the factor of evaporation in warmer climates. In order to obtain an even and effective deposit of a chemical upon all surfaces of the foliage of a crop when emitting the small amounts of liquid involved when low-volume spraying, the size of the droplets emitted must of necessity be small. Such small droplets of a water-based spray tend to evaporate very rapidly under tropical or semi-tropical conditions, and this evaporation has restricted the adoption of the low-volume technique in many territories. Results, which have been obtained over the past two seasons in various countries, suggest that oil-based insecticides and fungicides seem to offer a method of overcoming the evaporation factor. Some of the results obtained have been quite remarkable, and a few of these results are discussed below. In Guadaloupe the I.F.A.C. Research Station has been working for some time on the control of leaf spot (*Cercospora musae*) on bananas. They have done a great deal of work on the problem of applying fungicides as air-assisted low-volume sprays using a long-range blast-spraying technique. They discovered that such treatments were ineffective if the fungicide was merely suspended in water. Upon adopting the following spray formulation—4 gal. of white oil, 4 gal. of diesel oil and 17½ lb. of copper oxychloride containing 50% copper — they discovered that they could obtain excellent control of both banana leaf spot and false mosaic, using a total of only 5 gal. of this mixture per acre. What was remarkable in their findings was the fact that despite the very high percentage of commercial diesel oil in the sprayed liquid no scorch occurred. It was possible to obtain scorch deliberately when applications of pure diesel oil were made as shown in Table 1. Further work showed that they could obtain a very satisfactory control of leaf spot and false mosaic with reduced amounts of the actual copper fungicide per acre.

TABLE 1

Formulation	*Dosage, gal./acre*	*Phytotoxicity*
Diesel oil	5	Bad
Diesel oil 10, White oil 30, Copper oxychloride 8	5	Negligible
Diesel oil 10, White oil 2, Zineb 1	5-6 12	Negligible Appreciable

DDT-containing sprays

In the Sudan Gezira the cotton capsid and cotton fleabeetle have been controlled for some time by using DDT dissolved in various solvents undiluted by water. Good results have been obtained when 25% and 40% concentrates of DDT have been applied at 0.4 and 0.25 gal. of spray respectively per acre. Scorching of the leaves of cotton plants by these DDT concentrates has been shown to be virtually eliminated by avoiding large droplets. When such concentrates are applied by drift-spraying from a land-based machine it is possible to spray cotton at a rate of 2-4 acres per minute. When drifted over a similar swathe from aircraft a highly satisfactory degree of control of the cotton jassid has been achieved in large-scale experiments at a rate of nearly 50 acres per minute. Such a drift-spraying technique with water-based insecticides would be impossible in the Sudan owing to the very rapid evaporation of small droplets.

In Zanzibar, as was reported in WORLD CROPS, **6**, 488, 1954, the Coconut Pest Research Authorities have been able to obtain 99% control of one of their most important pests, *Theraptus* sp., with as little as ¾ gal. of 30% DDT in Sovacide F per acre. Sovacide F is a highly phytotoxic material and yet, when applied through an air-assisted low-volume sprayer at rates of up to 1 gal. per acre to oil-sensitive trees such as cloves and citrus, no damage results.

Many cases can be cited where locusts have been destroyed by using a drift-spraying technique and apply-

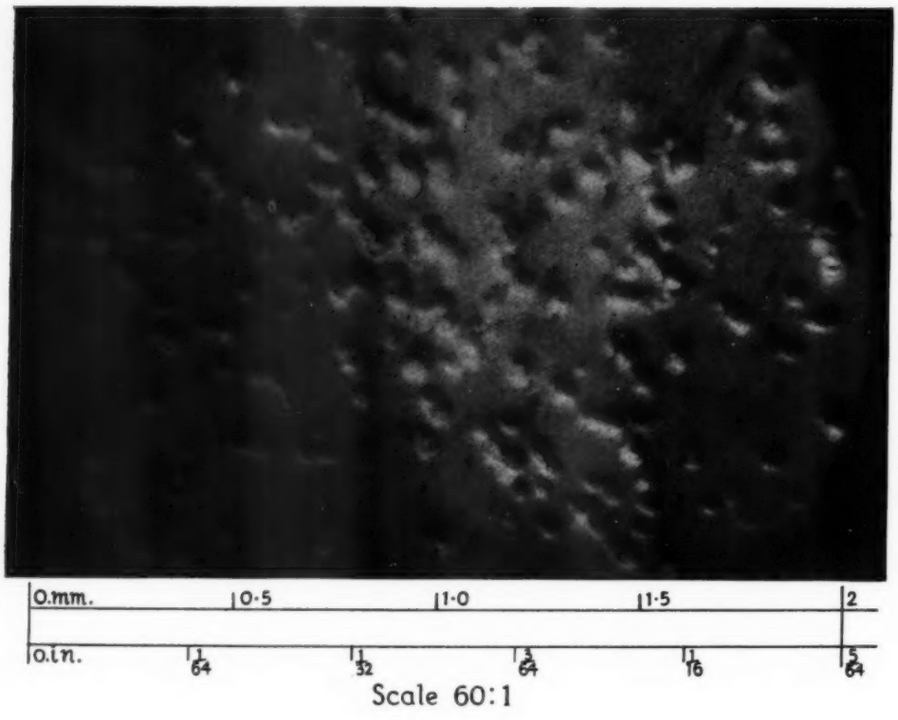

Fig. 1. 40-micron oil droplets on a magnesium oxide plate showing a deposit of 50,000 droplets/sq. in. This deposit was obtained when 2 gal. of spray per acre was applied. The total contents of the 200 droplets shown on this picture are equivalent to 1/25,000 of the contents of an average drop from an ordinary water tap

ing very small quantities of a 20% solution of D.N.O.C. in diesel oil.

Several questions are posed by the results obtained in the above experiments. Perhaps the most interesting of these is: Why did no scorch occur when diesel oil and similar solvents were applied to crop plants? Diesel oil is often recommended as a fortifier for total weed killers. The addition of either white oils or insecticidal material may have the effect of reducing the phytotoxicity of the diesel oils.

The French workers were obtaining a cover of 750 droplets per cm.^{2}. The type of cover obtained when using an air-assisted low-volume sprayer is shown in Fig. 1. It can be seen that the individual oil droplets all maintain their identity upon the surface and have not run together to form larger drops.

Evaporation of small droplets

It has often been assumed that the evaporation of small droplets of water was controlled by the temperature and humidity of the air through which the droplets were passing. Recent work carried out by Courshee of the National Institute of Agricultural Engineering suggests that a more important factor may be the amount of radiation (sunshine) to which the droplets are exposed. It seems that there is ample scope for further research on the whole problem of spray evaporation.

It appears possible to obtain satisfactory control of insects and diseases with smaller amounts of active chemical per acre when these chemicals are applied as an oil-based rather than a water-based spray. One suspects that the cover obtained is more satisfactory or that the oil itself may have some fungicidal or insecticidal value. The oil may play some synergistic role in the spray liquid.

Research required

The use of oil-based sprays is only in its infancy and there is need for much more work by manufacturers and research stations before their true value can be assessed.

It is interesting to note that the early practical work on oil-based crop protection materials has been carried out by workers in the field who were impatient to obtain satisfactory methods of solving their problems. Chemical manufacturers have done much to encourage and advise upon various aspects of this work.

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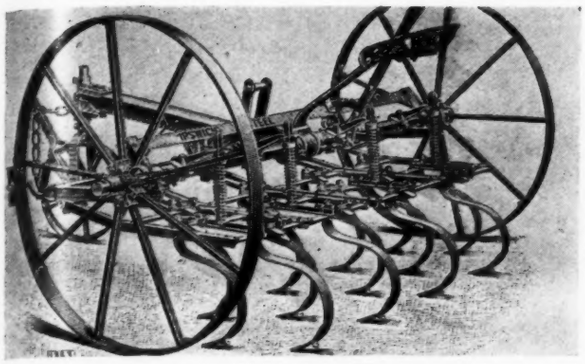
Plastic Tubing for Cold Liquids

A new range of plastic tubing has been introduced for domestic or industrial plumbing and for all cold liquid conveyance. Available from Shires and Co. (London) Ltd., of Guiseley, Yorks, in all standard sizes up to 12 in., the new ' Shirene ' piping is claimed to possess not only sufficient elasticity to withstand high pressures and the expansion of water into ice, but complete immunity to corrosion by acids, alkalis, salt water and chemical solutions.

The new tubing is supplied in two alternative gauges—normal and heavy. Standard screwed and compression joints may be used with the latter, but the normal gauge cannot be threaded and compression sleeve jointing is, therefore, recommended. Alternatively, both gauges can be very easily butt-welded by softening the ends near a source of radiant heat and pressing them together.

A wide range of applications can be met in agriculture in distributing water to outbuildings, cattle troughs and so on. It is stated that mole ploughing has proved a very efficient method of laying ' Shirene ' tube.

The tubing is supplied in multiples of 50 ft. up to a maximum single length of 500 ft.



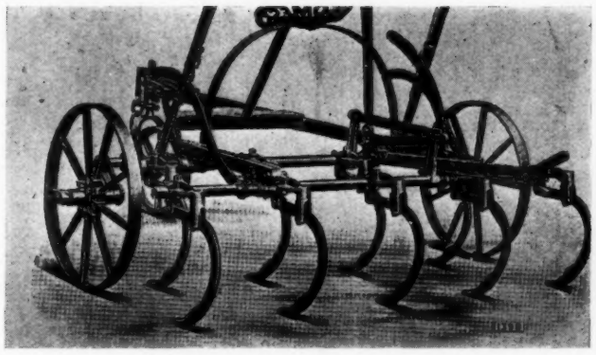


Fig. 9. (*Left*) **Horse cultivator, 'Ipswich,' three-horse haulage, 13 tines covering 5 ft. 5 in. Fig. 10.** (*Right*) **Heavy horse cultivator, 'Orwell,' 1 ft. 9 in. clearance between front and back rows of tines. The implement was specially designed for foul and very rough ground**

The Evolution of Tillage Implements—II

NORMAN L. GOODLAND

In Part I of this paper, WORLD CROPS, *7, 1955, the author traced the evolution of tillage implements from the Neolithic age up to the 19th century. The author concludes Part II by bringing the account up to date and a reference is made to the subsoiler.*

AS steam cultivation made progress it was widely believed that steam would supersede the horse teams but long before the 1920s it was clear that this would not come about. It was mainly the size, weight and expense of steam tackle that confined it to the larger farmer and the contractor, but horse-drawn cultivating equipment continued to be used until well past the 1920s.

The 20th century—the first 20 years

It had now become clear that, whereas steam cultivation was thorough, it was also coarse and very injurious to the soil under many conditions. Steam, therefore, became complementary to the horse teams and by the 1920s its main work on the land was to grub-up unclean or fresh land for subsequent horse operations, or the drag harrow was used after ploughing.

Harrows

Basically, harrows did not undergo a great deal of change. The zigzag principle remained; a standard width of 3 ft. was used and the harrows were made up into sets of three attached to whipple-trees. The reason for this standard width was that if one part of the old-fashioned wider harrow met a protruding obstacle many of the tines were lifted right out of the soil as the implement passed over it. These light sets required only one horse to draw them, but there were intermediate sets for two horses and heavy sets for three.

Curved-tined drags were popular in the 1920s. These were used after the cultivator and the curved tines were especially useful in cleaning dirty land.

The spring-tined harrow was also evolved; this consisted of a number of curved spring tines on a rectangular frame. This frame was divided into three sections, the sections being hinged to each other parallel to the line of draught, and each section fitted with a handle to regulate the depth of the tines. By this hinging arrangement of the sections, and by the action of the spring tines, it was possible to use the implement on fairly rough ground without fear of it being raised out of the soil by unyielding obstacles.

Straight-tined drags were also used on light, shallow soils, where it was desirable not to unearth the trash turned in by the plough. Flexible harrows were much improved upon, especially those used on pasturage, but the greatest improvements were to await the more powerful draught of the better types of tractors.

Cultivators

Many lessons learned in the evolution of earlier cultivators were and are incorporated in the construction of horse- and tractor-drawn implements (Figs. 9 and 10) of the period under review. In particular, the triangular frame construction remained. This is clearly seen in the horse hoes. Some were designed for single row cultivation and had a single leading tine at the apex of the triangle with a V-shaped foot, the other two tines at the rear corners of the triangle having right and left L-shaped feet directed inwards. This hoe was designed for one horse, but there were others, with seven cultivating tines fitted with V- and L-shaped feet, or with 10 or more tines for hoeing roots or wheat; these required teams of two or three horses to draw them.

Other forms of cultivating implements, such as horse hoes, scufflers, grubbers or scarifiers, of this period are far too numerous to mention here. The heaviest of these required a team

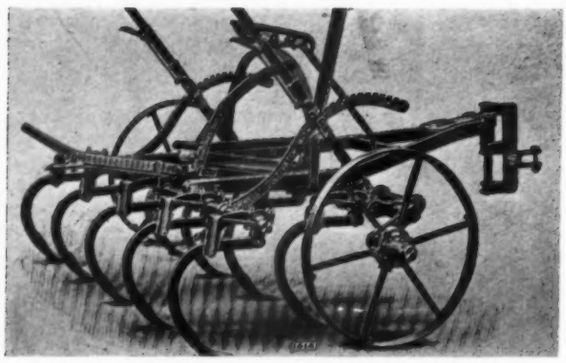


Fig. 11. Early tractor cultivator, weight 6¾ cwt., nine tines, width of work 6 ft. 9 in.

of six horses to draw it. Usually it had six stout tines arranged in a triangular frame, and by now cultivator design was such that the implements, by means of staggering of the tines and length and curve, no longer fouled themselves when working through long vegetation. The heavier cultivators usually had chisel-shaped shares, sometimes reversible, and carried a seat for a driver, and a hand lever and foot trip to raise the tines when required, as in the horse rake. The handle also served to fix the depth of the tines in the soil by means of an easily worked notched regulator; the tines were sometimes rigid, sometimes semi-sprung. The use of the heavy horse cultivator (Fig. 10) was mainly for breaking up furrows so that the harrows could be brought to bear upon the soil.

It is interesting to note also that disc cultivators and disc harrows were not unknown to horse draught. Whether they evolved from the disc coulter upon ploughs and drills, or from such implements as the Cornish disc roller of the early 19th century, or Darby's steam digger of mid-19th century, is problematical; but under horse draught they were not much favoured. In this country they were, and still are, regarded as weed promoters, especially where their action divided the roots of couch on land afflicted by this scourge.

Rollers

Various types of rollers, some with serrated discs as in earlier times, were in use in the 1920s, but the most efficient of these was the Cambridge roller. This had rings 3 in. wide, with tyres of triangular section threaded to a shaft with bearings. As the roller turned on the headlands each ring turned on its own. It was found to crush clods better than any other roller, to be most efficient in compacting the ground, and that the triangular section of its tyres prevented clogging. It was also used to destroy small seedling weeds by using two such rollers one behind the other, the rear one so adjusted that its depressions in the soil fell between those of the leading roller.

Smooth rollers were also in use, and in Fream's 'Elements of Agriculture for 1920' an account is given of wooden rollers, which, he says, 'are very useful in special cases, as when it is desired to break small clods without consolidating the soil more than is absolutely necessary.'

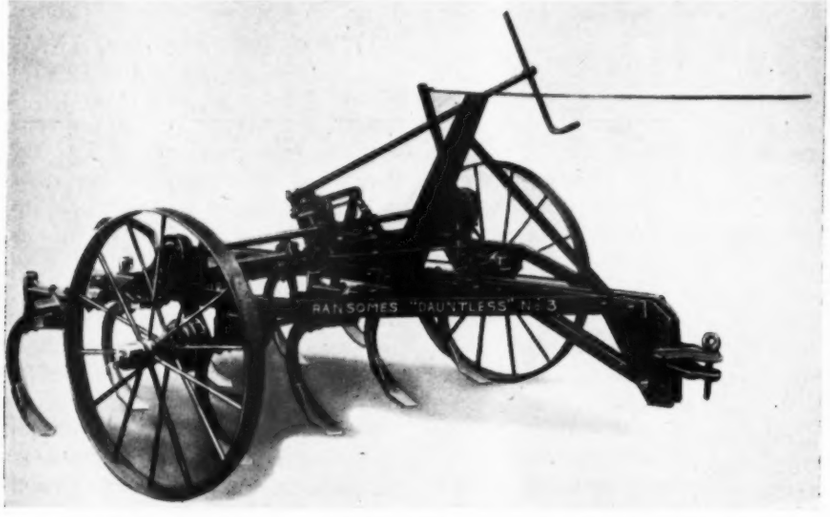


Fig. 12. 'Dauntless' No. 3, spring-tined cultivator for wheelless tractors

The tractor

The tractor was, of course, later to give rise to further vast modifications to tillage and cultivating implements (Fig. 11). In 1897, Hornsby's won a silver medal at the Royal Horse Show with an oil-driven tractor. Later developments aroused much interest, but during the 1920s tractor development received a setback because so much arable land was put to grass. Fream said, in 1920:

'Considerable progress has been made in ploughing by direct traction, the light motors being driven either by steam or internal combustion engines using petroleum, petrol or alcohol. The light motors . . . besides ploughing, will haul loads, or, by a belt, can be used for driving machines. . . . Motor ploughs for working various depths and widths required have led to the design of special ploughs, adapted to meet these requirements, and to withstand the pull of the tractors.'

There were many deep-rooted prejudices against 'direct traction' left over from the age of steam. It was still felt that the tractor was too heavy on seed land. Farmers were apt to attempt to overload the tractor and complain because it would not stand up to the work; Fream laid down a rule that the all-purpose tractor should be able to pull a three-furrowed plough at a suitable speed and depth, and if it could do that it could do anything required of it. Farmers were also wary about having highly combustible material like petrol on their premises, and more anxious still at the idea of placing it in unskilled hands. However, the tractor gained popularity, as can be seen by the tillage implements made especially for it between the 1920s and the second world war.

The second 20 years

Towards the end of the 1920s, real interest in tractors increased and the

machine became more and more indispensable upon all types of farms, as is shown by the following figures. In 1931 20,000 tractors of all types were in use on British farms; this rose to no less than 60,000 in 1938, and 10 years later 260,000 were in use. With greater haulage power contained in increasingly compact and efficient machines, all sorts of modifications to tillage and cultivating implements became possible. Seed harrows could be mounted upon wheeled whippletrees 30 ft. across. Flexible harrows could carry steel knife-edges clamped or riveted in to cut through the clods or tear away matted pasturage. Some were made with long tines on one side, short on the other.

Another modification was the 'pitch-pole' harrow. This had a double set of tines, one set riding upwards while the other was at work, and by means of a trip-cord positions could be reversed when the set in operation became fouled.

Yet another modification was the 'tipple-toe' harrow; its principle consisted in having an axle across the middle of the set, with a half-wheel at each end. In operation the harrows rode with the base of the half-wheels skimming the ground; on being tripped, these half-wheels came into use, thus lifting the whole set and allowing fouling material to drop off the raised tines.

A few years before the second world war the motorised hoe took over the work of the old horse hoe, especially on market gardens. They were mounted on pneumatic tyres and the

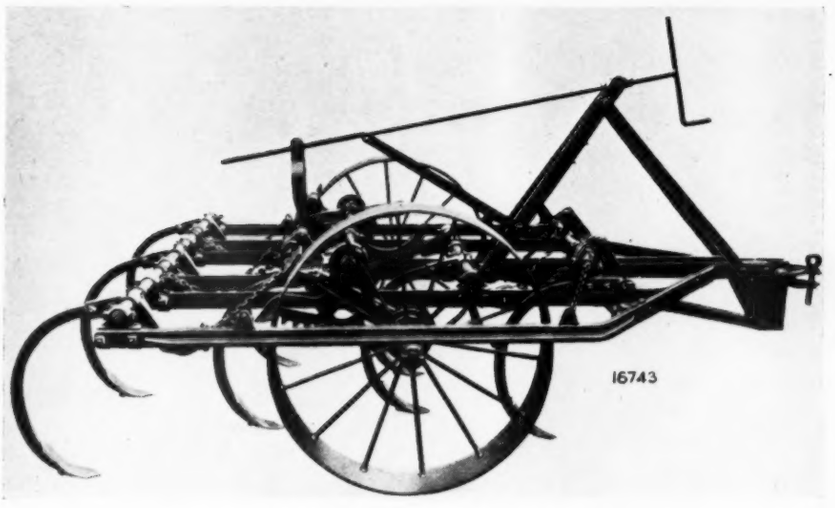
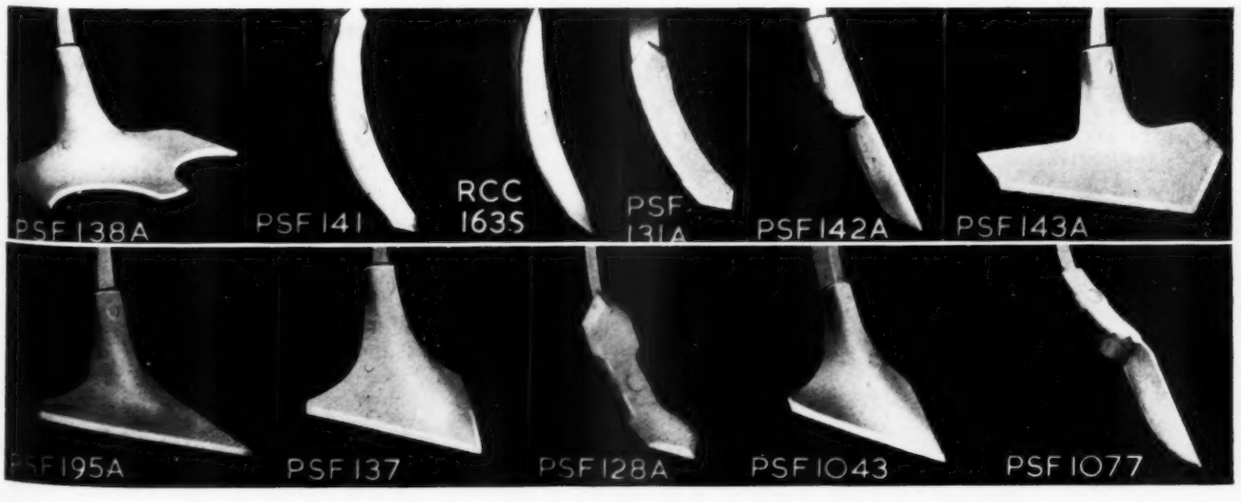


Fig. 13. 'Equitine' for wheeled tractors

triangular frame carried the engine, seating for the driver, and tools. Steerage was by levers, tillers or wheels. These hoes were cheaper to run than the tractor and not so heavy on the land or so wasteful on headland cultivation. In addition to this, various forms of trailer hoes were introduced. One of the most successful carried seats for up to five operators, each having a pair of handles by which he could open or close double hoe blades to avoid the plants, thus cultivating between the rows and between the individual plants in one operation.

Mounted toolbars became popular, not only on larger market gardens, but upon the farms. These were originally rear-mounted, with hand levers for lifting the implements out of the soil, but, as the tools tended to swing out a little in a direction opposite to the turn of the tractor steerage wheels, side- and forward-mounted toolbars were developed. Rear-mounted toolbars were quite satisfactory on large farm areas and are common to this day. They carried cultivating tines, ridging toolbars and almost all other tillage and cultivating bodies except the ploughshare and the harrow. Later, the pneumatic and hydraulic power lift was introduced, and also steerage toolbars, these carrying an operator who kept the tools between the rows by means of a steering wheel attached to a swivel wheel at the back, which also carried the weight of the toolbar. The track of this wheel was rubbed out by the following tine.

Rotary cultivation did not completely die out after the early experi-



Figs. 14 (*above*) **and 15** (*below*). **Points for toolbars and light cultivators**

Fig. 16. Heavy cultivator, C17, at work

ments of the steam age. Market gardens have used small motorised rotary hoes since shortly before the second world war and some trailer types were developed for the farm tractor. At the moment the chief objections to them are that they cannot bury trash or manure, are useless on grasslands and make a 'fluffy' tilth which beats down into a 'sad' or 'capped' condition.

With tractor haulage the disc harrow now became a more practicable proposition. It became widely used on the farms and took the form of two 'sets,' one behind the other, each 'set' consisting of a 'gang' of discs. The two front gangs were arranged with discs facing outwards, the second two with discs facing inwards. Thus there was a double action, the front set throwing the soil outwards, the second throwing it in. The principle of the disc harrow was penetration partly by weight and partly by setting it at an incline across the line of pull. It carried trays upon which suitable weights could be placed. Its shallowest work was done when all discs were set parallel to the line of pull, and penetration was increased by increasing the angles of the gangs across the line of draught. However, disc harrows will only penetrate by this means to a point; beyond that point, whatever the weight, they no longer function properly and only scrape the ground.

Rollers also underwent considerable development. Three banks of the Cambridge roller could be drawn behind more powerful tractors, and the smooth roller was also developed. This was increased in weight if the farmer desired it by filling it up with concrete. More scientific water-ballast rollers were made in which the weight of the rollers could be regulated. The furrow press had a press-drill attached to it and harrows trailed behind; this was very successful under certain conditions.

Cultivators were developed to such an extent that for some cultivations they were used instead of ploughs. Fig. 12 shows a spring-tined cultivator. The tine is hinged beneath the attachment to the bar of the triangular frame and the spring is contained in the upright tubular attachment behind the tine hinge. Tines can be spaced to suit varying crop conditions. In addition to this type of springing, a further modification can be made on very rocky land by the attachment of spring-mounted tapered spring-steel tines. The body will also carry rigid tines and the wheel-marks are obliterated by the tines directly behind them. These implements cultivate to a width of 6 ft. 3 in. and were designed for use with light-powered wheel tractors.

Another cultivator in use previous to the war by the same firm was the famous 'Equitine' (Fig. 13). In this the tines swing individually and are connected by separate chains coupled to compensating rockers. On meeting an obstacle an individual tine will swing backwards to clear it and, having done so, the compensating mechanism will draw it back into position without interruption in the work of the cultivator, or disturbing the uniformity of its depth in the soil. Both cultivators are lifted from the soil by the rack-and-pinion method, which operates on either wheel.

This period, 1920-40, saw not only the complete change-over from horse-drawn implements to the tractor, but also an enormous development in technical aspects of implement construction. Tractor haulage power could be measured with exactness and machines could be built to suit all types of farms, soils and the implements for working these soils. To give two examples: it was calculated before the second world war that cultivators working in heavy loam have a resistance of 4-5 lb. per sq. in. of working surface; that medium discs working on medium soils varied between 50 and 250 lb. resistance per ft. of width, according to their design, the soils they were to work on or their manner of use.

The 20th century—mid-century

Both seed and disc harrows have now been adapted for use with the three-point linkage and other types of hydraulic lift operated from the tractor. The toolbar has become an in-

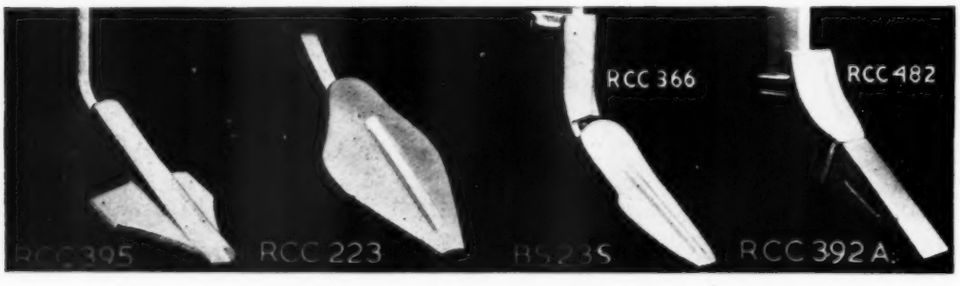


Fig. 17. Points for medium-heavy and heavy cultivators

creasingly important medium for all-purpose cultivations. It can maintain its depth irrespective of the rise and fall of the tractor, however uneven the ground. All types of bodies are adapted to it: ridging, hoeing, crop lifting and cultivating, either with rigid or spring tines. Even toolbar drills are made for it.

As is shown in Figs. 14 and 15, points have been developed for every conceivable operation or soil condition —these examples are but a few of those available to the scientific farmer.

Points which can be fitted to the toolbar and light cultivator are the 10-in. thistle - cutting point (PSF 138A), reversible points (PSF 141, RCC 1635), reversible points for spring-tine drags (PSF 131A), turf-cutting points (PSF 142A), wide cultivating points up to 12½ in. (PSF 143A), right- and left-hand points (PSF 195A), and points ranging from 3 in. to 9 in. (PSF 137). Various sizes of all these patterns are made. In addition, light-cultivator points are shown (PSF 128A, 3-in.; PSF 1043, 7-in.; PSF 1077, turf-cutting).

The peak of tractor-drawn cultivator development lies in heavy implements like the cultivator illustrated in Fig. 16. These monsters, weighing about a ton, are designed for tractors of from 35-50 drawbar horse-power and will cultivate to a depth of 12 in., with a width of up to 9 ft. Examples of points used on them are, among the medium-heavy cultivators, a cast chilled 10-in. point (RCC 395), a cast chilled 6-in. point (RCC 223) and upon the heaviest implements the 4½-in. cast-steel point (BS 23S) and the 2-in. cast chilled reversible point (RCC 392A) (Fig. 17).

No account of the evolution of tillage implements would be complete without reference to the subsoiler. Subsoil cultivation has been used for more than 100 years and today is undertaken in order to break up the ' pan ' formed beneath continuous normal cultivations, so that moisture can drain down and release minerals and other elements not hitherto available to the crops. It is also done with a view to increasing the depth of bacterial action, not only by providing access to these organisms deeper into the soil, but by increasing their activity through better soil aeration. Also it is believed to assist plant life during drought periods and to help in the control of ground and root pests.

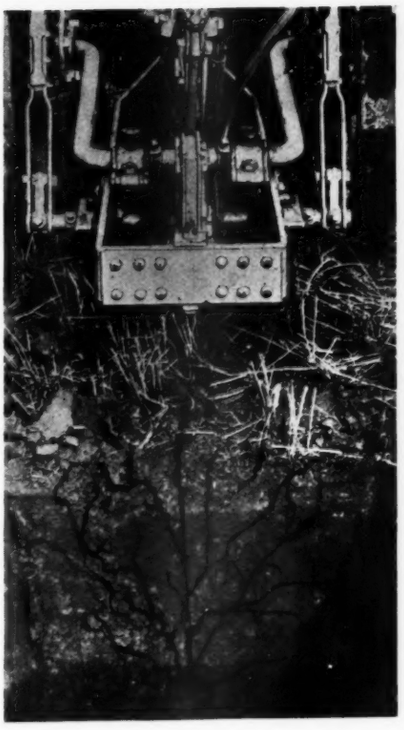


Fig. 18. Subsoil cultivation

Fig. 18 gives an excellent idea of the effect of this type of cultivation.

Conclusion

Such is the story of the evolution of tillage and cultivating implements, of which only an indication can be given in this account. Because of the varied conditions under which the British farmer has to work, old and new methods of tillage and cultivation are still used side by side. In some parts of the British Isles the wooden harrow, the wooden mouldboard, hand clod-breaking implements, the spade and caschrom, the bush harrow, wooden and stone rollers, the steam cultivator and horse teams are still in use, although Britain is considered one of the leading nations in the field of mechanised farming.

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R.A.S.E. Gold Medal for Sir James Scott Watson

The Royal Agricultural Society's Gold Medal for Distinguished Services to Agriculture is to be awarded for 1955 to Sir James Scott Watson, C.B.E., LL.D., recently retired Director of the National Agricultural Advisory Service.

The award of the R.A.S.E. Gold Medal was instituted in 1933 and has been made only 10 times previously.

Sir James Scott Watson, the son of an Angus farmer, left school at the age of 14 to take up farm work. He was successively Lecturer in Agriculture at Edinburgh University, Professor of Rural Economy at Oxford, Agricultural Attaché in Washington and High Commissioner in Canada before becoming Director of the N.A.A.S. and Chief Scientific and Agricultural Adviser to the Ministry of Agriculture.

Sir James is the author of the ' History of the R.A.S.E., 1839-1939.'

Coupled with the award of the medal, which, it is hoped, will be presented at the Royal Show next July, is appointment as an Honorary Fellow of the Society.

Technical News

The June issue of *Food Manufacture* contains the following articles: ' Packaging, Odour and Flavour Problems ' by L. C. Cartwright and P. H. Kelley; ' Preserved Foods for the Swedish Larder, 2 ' by C. H. Sporle; ' Heat Penetration into Canned Foods ' by S. M. Charlett, and ' Widening Horizons of Food Research.'

Muck Shifter for June includes ' Packing Engines for Export ' and ' Drilling to Tap the Power of Natural Steam.'

The contents of the June issue of *Petroleum* includes ' Geophysical Methods of Oil Prospecting—IV ' by D. T. Smith, B.SC., D.I.C., F.G.S.

Dairy Engineering for June contains articles on ' Fork Trucks in the Dairy '; ' Progress in World Dairying ' by A. W. Marsden, M.SC., A.R.C.S., D.I.C., F.R.I.C., and ' A British Approach to Dairy Plant Safety Problems ' by F. W. Thomas.

The June issue of *Manufacturing Chemist* is a chemical plant and engineering number.

Barley as an Irrigated Crop in Iraq

R. MACLAGAN GORRIE, D.SC.

Today, Iraq is one of the less-developed regions of the world. In ancient days it was one of the most fertile and highly developed areas, but it was brought to ruin by the invasion of the Mongolian hordes in the 13th century and has never recovered its former productivity. Recently, developments in the oil industry have enabled plans for rehabilitation to be undertaken by the Iraqui Government. It is envisaged that ultimately under this programme five million acres of cultivable land should be made available for occupation by five million Iraquis.

MESOPOTAMIA, the land of the twin rivers Tigris and Euphrates, has always depended upon the irrigation of the desert for its farming. Flying over Iraq today one is struck by the elaborate pattern of derelict canals; motoring across the desert practically the only landmarks are these remains of canal alignments. Many of them have only one bank, the other having been eroded away by the combined force of wind and water. There are also many traces of dams and diversion projects along the present river channels, and others can be traced in the old river courses long since deserted by the river itself. When Sir William Willcocks arrived in 1908 as an employee of the Turks, none of these old systems was in operation and the country was very largely desert, except for the date-palm gardens of the river banks and the rain-fed cultivation of the upland Kurdish tribes.

Agricultural activities

Unlike the Nile system of inundation with summer floods, the main agricultural activities of Iraq fall into five main types: (i) the *daim* or rain-fed crops, mostly wheat and barley in the northern uplands, which receive a rainfall of 8-14 in., enough to raise a winter crop if the rain is conserved in the soil; (ii) the *chibis*, using residual water from local flood diversion, plus subsequent winter rainfall of 6-8 in.; (iii) lift irrigation, using water raised from the main Tigris or Euphrates, and mostly now dependent upon diesel-oil-driven pumps to get the water into the fields, which all lie above inundation level—the main crop is again wheat and barley, but cotton, sorghum and vegetables are coming increasingly into use; (iv) diversion of flood water from the two main rivers into large canals, the first watering being dependent on the rise in the river resulting from snow-melt and rain in the distant hill catchments of the Turkish and Persian mountains; (v) perennial canals from barrages which give water regularly from November onwards, as they are not restricted to flood peaks and can use normal river supplies. Their sowing season is thus fixed to a much more regular time-table than with other classes of land where sowing dates depend upon timely winter showers.

Masons building a concrete inlet which will control intake of water from a main canal channel into a farm distributary on Latifiya Estate

The main activity of present-day planning under the various development projects is to supplement this last type (v) by storage-water dams along the various tributaries on the Tigris left bank, whose courses through the hills of the Persian border present some likely sites for large storage dams. Unfortunately, the water of the Tigris itself and of most of its main tributaries is fairly brackish with salt derived from gypsum and other salt deposits of the Bakhtiari geological formations exposed in those hills, so that if irrigation is continued without effective drainage the life of the land is only 30-50 years, as it then becomes too poisoned to raise crops. This process is hastened by waterlogging. Most of the irrigation colonies established since Willcocks's time are still without drains—in neglect of his own insistence upon early and effective drainage for every canal scheme—and they have already been badly affected with increasing salt in the soil, plus a rise in the water-table level, bringing it near the surface.

Effect of salt

Much of the land for which perennial irrigation is now being planned—for instance, the great stretch of desert along the left bank of the Tigris between Ctesiphon and Kut—is heavily impregnated with salt brought in by the ancient Nahrwan canal system. With a rainfall of 4-6 in. a year this flat desert should produce at least some salt-bush and thorn scrub, but one can go for miles across it without meeting any greenery at all, and in places where plants do occur they are mostly of the salt-enduring family of Chenopods (*Salsola*, *Suaeda*, *Bassia*, *Cornulaca*, *Atriplex*, etc., typical salt-bush types with grey flabby worm-like leaves). The thorny bushes *Alhagi*

maurorum and *Prosopis farcta* are indicators of possibly better and deeper soils. Such conditions can be readily identified in air photos.

Land that is already heavily impregnated with soluble salts, such as common salt, can safely be brought under irrigation, provided three essentials can be guaranteed. First, a complete system of deep drains must dovetail into the irrigation canal layout, even down to the farm drains for each field. This will give freedom from waterlogging for just so long as these drains are kept open and properly maintained, and will also provide for the removal of whatever salt is dissolved out. Secondly, an adequate supply of water to allow of the 'laundering' of the soil, taking up a block at a time for intensive irrigation, ponding back the water into each field and refreshing the supply before the surface can dry out. (Punjab practice is to use this 'laundering' water to produce three crops of rice.) The seepage will dissolve a certain amount of salt as it passes through the soil, and will carry it down through the subsoil and out into the open drain. The third essential is, of course, a fairly porous soil, for the soil above the drain level must be capable of allowing the water to pass through it and away. If it is so dense in texture that water will not travel downwards and outwards through it, the expenditure on canals and resettlement will be wasted. Hence the need for the detailed soil surveys, which are now in hand.

Winter growth of barley

It is curious to find barley as the staple crop in such tropical conditions, although it is a winter crop grown with the help of winter rains and ripens in the spring before the heat has become intense. The standard of cultivation is very poor, except in the case of one commercial company, the Latifiya Estates, which owns land and employs Scottish agricultural engineers. The Government farms produce better yields than the average cultivator, but none of them use fertilisers, and the normal practice is to depend on alternating fallow with barley year by year. Continued fertility under this sytem depends greatly upon the presence of a deep-rooted thorn bush, *shoq* (*Prosopis farcta*), which coppices and seeds vigorously as soon as the barley is cut.

Cattle grazing over a fallow in which a few tufts of *shoq* have sprouted since the barley was cut

P. farcta is almost the only source of fuel for cooking in the plains villages. This plant draws its moisture from 10-15 ft. down, but shows little on the surface when cleared off for cropping. After the cereal is harvested, the shoq's green shoots come up. Its value lies in counteracting the salting of the surface soil through the continuous shedding of its leaves to form a mulch during the hot season, and the deep root holes ensure continued porosity.

The early barley sprouts are often cut for fodder once or even twice before being allowed to grow up and form a grain crop. The normal sowing time for barley is earlier than for wheat in the central plains, but in Amara, towards the Gulf, the wheat is sown first. Sowings even in irrigated areas are largely dependent on timely rain, because it has been learned from experience that the too early use of canal water encourages rust and rampant weed growth. Wheat yields vary from about 20 bushels (of 56 lb.) per acre from the State farms down to 8 bushels per acre for the average bad cultivation. Barley yields are roughly about 80% of these wheat figures, for generally the better land is used for wheat and the poorer for barley. In both crops the Iraq yield is much lower than in the Punjab and Sind irrigated crops.

Barley stubble in an irrigated field near Daltawa in Iraq

Land tenure

The land tenure system is still largely feudal, each sheikh having a considerable holding which is cultivated by tenants, who have only a one-crop lease and are moved around constantly so that they cannot establish permanent homes. The need for biennial fallow is largely responsible for this. Many of the sheikhs with riverside land are themselves the owners of a diesel pump and a canal into which

Continued on page 249

Fig. 1. *Cannabis sativa* **seedlings after several weeks' growth**

Fig. 2. *Cannabis sativa* **plant, four weeks old**

Fig. 3. *Cannabis sativa* **plant, six weeks old**

Some Aspects of Indian Hemp

ROMILY D. CHANDLER

Indian hemp (Cannabis sativa), *a tall annual herb, is considered to be a native of western and central Asia. Three products are obtained from the plant—fibre, oil and the narcotics, Bhang or Hashish, Ganja and Charas. The methods of cultivation differ somewhat according to the product required. The plant is cultivated commercially for its fibre mostly in Europe and parts of China, Japan and the U.S.A. The plant is grown illegally for the narcotics it produces. The drug consists of the dried flowering and fruiting tops of the pistillate plants from which no resin has been removed.*

THE main purpose of this article is to try to describe a simple way in which *Cannabis sativa* was grown in the laboratory for instructional purposes. There is not very much written or said about Indian hemp these days, and most likely the reason for this is that it is not used in pharmacy to any great extent but, like opium, it is smoked and taken by the addicts just as it was many years ago, though in ever-decreasing quantities.

The observations contained in this article are made chiefly with regard to the growth of *Cannabis sativa* in Malaya, an area where perhaps one does not at first expect to find much of this drug, but like the remainder of the East is always associated with the consumption of dangerous drugs as a whole. The drug is known as Ganja in those parts but, as is well known, it has many other names in other parts of the world, although in all cases these may or may not be exactly the same species.

Illegal cultivation

When Indian hemp is found in Malaya it has been grown illegally, and has normally been confiscated by either Customs Officers or the Police, more often the former. Persons interested in growing the drug may do so for home consumption or for sale on the illicit market, and, since the market is unfavourable at the present time and there is quite a risk in selling the drug, the customer has to be well known. Most of the prepared drug goes into the home of the producer. As mentioned above, growing is a very precarious job and has to be carried out in out-of-the-way places, e.g. between other crops or in the homes of the producers, so that it cannot be readily seen. In one unusual case a whole plant which had been grown in an old bucket was confiscated. It was really this incident that created the idea of trying to grow Ganja in boxes in the laboratory as there was little known of the growth of the plants locally and it was thought that a study of the growth of the plant from seed to maturity may be of some use in rapid identification.

It is correct to state that Ganja is very rarely found growing nowadays in Malaya, and it is not very often that the prepared drug is found. Such methods of production as the use of the bucket mentioned above may have something to do with that, for it is relatively easy to put the bucket out of sight at moments when it is most likely to be observed. The responsibility for enforcing the Dangerous Drugs Act in Malaya rests with the Customs Authority and the Police, and the larger quantities of drugs confiscated are usually those obtained by officers of the former organisation.

Fig. 4. Flowers on a branch of a male *Cannabis sativa* plant

Fig. 5. Flowering section of a female *Cannabis sativa* plant. The fruit is an ovate seed-like achene

Experimental cultivation

It was decided to grow some plants and to study them in their growth from seeds to maturity and to make photographic records at various stages of growth. From these records it was thought that it would be made much easier to recognise the plant at a glance, and this would appear to be to some extent successful. From a horticultural point of view it is doubtful whether growth was under ideal conditions, for the plants' requirements in this respect were not known. The plants obtained were the best under the prevailing conditions and not necessarily typical of plants grown under optimum conditions.

The first attempt was not good and was attributed to the fact that the seeds, which were taken from a museum collection, were of doubtful age. However some did give rise to small seedlings which were very quickly devoured by small rats which frequent that part of the world. However this did provide some useful experience.

It became evident after a number of trials that if these plants were to be successfully grown the following points required maximum consideration. A fairly rich soil was apparently necessary and this was prepared by mixing a quantity of local natural manure with local soil, which contained plenty of humus. Then it was essential to offer the plants maximum protection from pests. This difficulty was overcome by placing the boxes on a ledge outside a window where it was extremely difficult for animal life to venture. It was found that *Cannabis* required a good deal of sunshine as would be expected for a plant growing in the open in the tropics, and the ledge served this purpose at certain times of the year. In order to gain this experience it was necessary to raise several crops of seedlings and Fig. 1 shows the results when the seedlings had been growing for several weeks. It is possible that these plants were small when compared with those grown under ideal conditions, e.g. if grown in the open with maximum amount of light and in soil with the required mineral content, but it is essential to remember that these specimens were grown almost entirely under circumscribed conditions, and in boxes of limited size to enable them to be easily transportable.

Leaf arrangement

Figs. 2 and 3 show that an attempt was made to record the rate of growth, but this was given up at later stages because there was such a wide variation in rate of growth between individual plants that it was considered to serve no useful purpose. These photographs do, however, give some idea of the leaf arrangement on the main stem and also the shape of the leaves. Photographs were taken of plants which were thought to be typical specimens, and the heights reached were approximately $2\frac{1}{2}$, $4\frac{1}{2}$ and 11 in. in four, six and 12 weeks respectively. The leaves, which were palmate in shape, contained varying numbers of leaflets, and in the case of the mature plant the number was in one case found to be 11, but this was not a good specimen; the younger plants had sometimes five leaflets on each leaf.

It was necessary to wait about eight months for the flowers to bloom; the male plant (Fig. 4) produced a mass of

leaves and small white flowers. The flowers did not last long but commenced to bloom in the morning and the petals were ready to fall the following day. The female flowers (Fig. 5) were small and inconspicuous, and it was not long after the flowers had become visible that seeds began to form; the flowers were green in colour and gave rise to small brown seeds which were normally very numerous. Figs. 4 and 5 give in some detail the general appearance of the male and the female flowers as they were seen on plants raised from seeds.

A point worth noting is that only the female plant is of direct interest to the consumer, whether it is to be smoked or taken internally. It is only on the leaves of this plant that the resin cannabinone, which consists of a mixture of cannabinol and a number of isomeric tetrahydrocannabinols, is found, and then only if the plant is grown under the appropriate conditions. Tests were therefore made on leaves from those studied and the presence of the resin was confirmed, thus showing that a certain amount of success had been achieved. At the same time the results showed that when *Cannabis* is grown under very artificial conditions full effects of the drug can be obtained on smoking the dried leaves.

When the plant has been confiscated it is always necessary to prove that it is *Cannabis sativa*. It is unlikely that much trade would be carried on with the male plant. Usually the male plants are removed as soon as they are detected as the resinous secretion is formed in unfertilised female plants, and therefore most specimens reaching the laboratory are female. However both chemical and microscopical tests have to be carried out in order to rule out the fact that the dried drug may have been derived from the male plant. It is not permitted to grow Indian hemp and therefore the male would also be classed as a dangerous drug.

Hungary Makes Own Tea this Year

The first Hungarian tea will be made this year from leaf grown in Hungary, says an article in the journal *Life & Science*, which sums up progress in domesticising various industrial crops in Hungary.

Tea seeds of a frost-resistant hybrid type were received from Georgia, in the Soviet Union, in 1953, and experimental growing was begun by the Keszthely Agricultural Institute in the Nova district of Zala County.

There are now about 1,200 plants, which have stood up to snow and frost. Although the first experimental quantities of Hungarian tea will be made this year, at least another five years' observation is required before researchers can be satisfied that the plant is fully adapted to the Hungarian climate.

The cotton harvest in Hungary

News of other experimental crops included:

Rice: This is now well established and was grown last year on 112,000 acres. Out of 103 types tried since the first experimental crops were put down about 15 years ago, the Turkestan Dunghan Sali variety was found best.

One of the biggest problems has been to breed a domestic variety resistant to bruzone, and after many experiments the Szeged Institute has selected a variation of the Turkestan-type Arpa Sali, which it has called Szeged Bearded. Although rice is now being harvested in such quantities that Hungary has a small surplus for export, research on resistant types, including one from Rumania and another from the Soviet Union, is still in progress.

Groundnuts: Experimental growing is being carried out in the extreme south-east of Hungary, using the Valencia type. In the region of Medgyesegyháza small farmers are producing on several hundred acres and the Mako Experimental Farm is carrying out tests on 112 acres.

Lemons: Lemon, orange and mandarin growing is still being developed. They have been grown successfully in pits and trenches, but the winter covering is regarded as too costly. It is more general now to grow them in glasshouses. The Keszthely Experimental Institute is still working towards a satisfactory outdoor lemon which is sufficiently frost resistant to do without trenches.

The ditches for lemon growing at the Agricultural Plant Cultivating and Research Institute, which was established in the trans-Danubian village of Fertod

Figs: The Keszthely Institute is trying to find a fig which can be grown economically. The fig has been grown in Hungary for many years, but little of the second crop ripens. Hybrids have been brought in from Bulgaria for experimentation.

Rubber: Field production of Koksagis, the 'rubber dandelion', has now been stopped as yield and production costs showed it to be uneconomic.

Sweet potato: Experiments to domesticise the Batata (or sweet or Spanish potato) are going on at the Fertöd experimental farm. The main problem is to find a type which will store well.

Agriculture in the Soviet Union—II

W. G. CASS

The author concludes this account of the trends and developments in Russian agriculture by noting the controversy that surrounds the theories propounded by leading agriculturalists, particularly Williams and Lysenko. Polemic has played a major role in the development of post-Revolution agriculture and tremendous importance is placed on this development. Williams, in 'Principles of Agriculture,' sets the target for Russian agriculturalists by saying, 'On a basis of widely fluctuating yields it is impossible to build a long-range, planned and progressive socialist agriculture. We must have high and stable yields. The Bolshevist Party, the Soviet Government, the great Stalin himself have called on us to attain this goal which can only be reached by the adoption of a scientific system of agriculture.'

AMONG the leading figures in Soviet agriculture today must be included W. R. Williams, the author of what has become a standard work on the 'Principles of Agriculture,' and T. D. Lysenko the author of a volume on 'Agrobiology,' of which an English edition has been published (1954) in Moscow. Lysenko appears to have been discredited in later years and his theories have met with considerable opposition and criticism in many quarters. A recent article by him 'On the problem of species and species formation and its further study' was the subject of a keen discussion recorded in *Bot. Zh.*, **39**, 202, 1954; this was followed, in the next issue of that journal, **39**, 357, 1954, by an article by S. S. Khokhlov (Director of the Agricultural Department, Saratovsk State University), from the point of view of practical agriculture, in which the views of Lysenko and his school are condemned. A brief summary is given below.

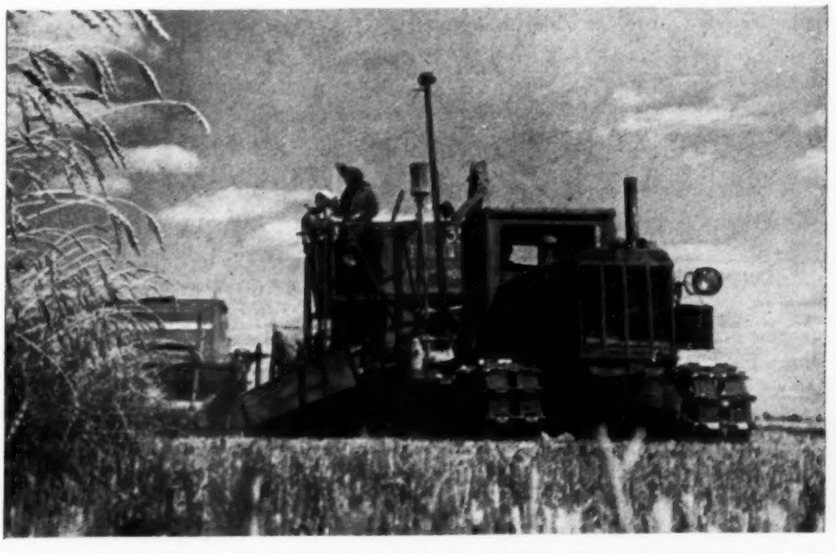
The work of Williams and Lysenko

The agronomic teaching of Williams has been generally accepted and widely adopted—almost too widely, as indicated by N. Tsitsin (Part I). It requires a certain amount of discrimination and intelligent adaptation to local conditions. The first four chapters of his book relate to soil fertility and plant requirements. He then proceeds to unfold his now well-known *travopolye* (grasslands) system, or the grass-arable system developed from the earlier work of P. A. Kostychev. Succeeding chapters relate to soil cultivation, pre-sowing cultivation, green-fodder fields and fodder rotation, chemical conditions of soil fertility and mineral fertilisers.

An interesting description of the grass-arable system is preceded by some account of the fallow system, of which two forms are noted—manured and unmanured. Differences between the fallow and grass-arable systems are also noted, including the fact that the latter must be studied according to the topography of the land, which comprises three main parts: watershed, slopes and bottom land. The watershed must, in most cases, be forested and two suitable rotations must be adopted for the slopes and valleys, namely the so-called fodder rotation and arable rotation respectively, based on considerations of available water and plant food.

Arable rotation

The arable rotation in the grass-arable system is discussed in some detail in relation to perennial grasses and annual field crops, with emphasis on the importance of grass and its selection. Other important points are the place of grain crops and of 'technical' crops (sugar beet, potatoes for industrial use, oleaginous crops, etc.) in the rotation. Perennial grasses such as timothy, clover, lucerne and wheat grass are particularly valuable for building up humus supplies in the soil; annuals are almost useless for this purpose and supply fodder only; peren-



A combine harvester of the Zerkalskaya MTS in the wheat field of the V. M. Molotov collective farm

nials provide both fodder and humus.

Opinions differ as to choice of grasses in the arable rotation. Some maintain that the proper function of the short ley is to produce fodder and the more the better. Others, whilst fully admitting this, consider it wrong to infer from such consideration that only legumes such as clover or lucerne should be sown. From a discussion of their root systems and value in soil structure the author gives his reasons for deciding that the ley in the grass-arable system should include a sufficient quantity of perennial grasses. A very good seed mixture is two-thirds of legumes and one-third of grass. The problem of the correct species to be used in the grass-legume mixture has been answered scientifically for two sharply distinguished zones—the northern and the southern. For the former, timothy and red clover; and for the latter (south and east of the Soviet Union), crested wheat grass and yellow or hybridised lucerne, in accordance with the experimental results obtained by Prof. V. S. Bogdan at the Krasnodar Institute. (Some remarkable illustrations show the extraordinary difference in root systems, *e.g.* of lucerne in irrigated land (*a*) from a pure or unmixed sowing and (*b*) the same lucerne sown in admixture with French rye grass, showing a dense branching mass in the top 12 in. of soil.)

Another very interesting point is the time for ploughing up and cultivating the grass field. Mistakes here may ruin the whole scheme, and the selection of the wrong crop after grass, *e.g.* any winter crop, with consequent wrong ploughing time, may neutralise the results of two years' work. The importance of a spring crop after late autumn ploughing is emphasised.

Scientific polemic

An interesting chapter could be written on the nature and extent of the criticism that Soviet scientists level at each other. It is often more bitter and acrimonious than that of foreign critics. Lysenko is a pertinent example. From the very beginning of his work he has been subjected to adverse criticism and even ridicule, and it is most difficult, if not impossible, to say to what extent his reputation has suffered in recent years. In his 'Agrobiology'—in many ways a masterpiece of Soviet agricultural literature—he himself cites an example of such ridicule. On p. 205 (English edn.) he says (on the subject of intravarietal crossing): 'In 1936, on our suggestion, collective farm laboratories for the first time began to use tweezers in order to test Darwin's proposition that the cross-pollination of plants subjected to long continued self-pollination is beneficial. Some scientists hastened to ridicule this proposal. They even cracked jokes about it and said, "Lysenko and Prezent propose arranging marriages for love among plants." . . . To the scoffers we say, "You don't believe now, but see the results of this experiment in a year's time." Some people laughed at vernalisation, at the summer planting of potatoes and at the topping of cotton plants. But . . . are not laughing now. We are convinced that in a year from now it will be the same with intravarietal crossing.'

It is, of course, impossible to give anything like a review of this large volume here, but it appears fairly certain that, in 1948 at all events, when he read his famous paper on 'The Situation in Biological Science' before the Lenin Academy of Agricultural Sciences, Lysenko was acclaimed by his large and distinguished audience.

However, as mentioned above, we do not know precisely how Lysenko stands today in the opinion of his fellow biologists. What we do know from a study of Lysenko's own writings is that he was quite capable of defending himself and of answering scorn with scorn.

In the editorial review of a discussion 'On the problem of species and species formation and its further study' (*Bot. Zh.*, **39**, 1954, 202), some attempt seems to have been made to disentangle purely scientific considerations from political and ideological contamination and to present a more objective picture; this is a welcome feature in Soviet scientific (or quasi-scientific) discussion. The problem is, of course, fundamental in biology and 'only by collective efforts and under conditions of free conflict of opinions can its true solution be undertaken in accordance with the present state of science and of practice.' The discussion has proceeded far beyond the limits of this particular journal into many other Soviet biological, agricultural, philosophical and even literary-artistic journals.

The debate has ranged over wide fields and has included Darwin, Michurin and many others. More specifically the questions considered were: (1) Can individual cases of 'breeding' species be regarded as a basis for a new theory of species formation? (2) Is there actually a complete absence in nature of gradual transition between species and what is the correct order of ideas in regard to 'jumps' (sudden transition) in living nature? (3) Is it permissible to suggest 'granules' of a new body in age in relation to the vegetable world? (4) Is there actually in nature an absence of inter-species struggle for existence among plants, and is it possible to deduce therefrom definite ideas of species? (5) What role in species formation is played by natural selection and what should be our present evaluation of Darwinism? (6) Are those criteria that Lysenko postulates sufficient for defining our conception of a species?

Species formation

Possibly of more practical interest to the agriculturist was the somewhat caustic contribution of S. S. Khokhlov, presenting ostensibly the standpoint of practical collective farming (*Bot. Zh.*, **39**, 1954, 357). Among other things Lysenko and his followers are charged with ignoring all facts that do not fit their theories. The special case of 'breeding' specimens (individuals) of soft wheats from hard (durum) wheats is considered in some detail in connection with wheat breeding generally, and recent Soviet work in this field. Various facts are adduced as a result of this work that the Lysenkists are asked to explain on the basis of their new theories of species formation. In the same field of research are given some recent results on the 'palingenesis' of populations of hard (durum) wheats into populations of soft wheats, with special reference to the investigations of P. F. Sekun. The attitude of Lysenko and his followers to these results is said once again to illustrate their arbitrary manipulation of facts. Khokhlov finally considers the question: Into what kind of blind alley will practical farming be led by the sponsors of the 'new science of species'?

The author certainly presents some apparently strong grounds of criticism

against the Lysenko school. But Lysenko, the author of more than 350 articles and pamphlets, is well practised in answering criticism.

Trends in genetics

From the beginning he has been working in an atmosphere of controversy and sharp criticism. In the paper entitled 'Two trends in genetics,' at the fourth session of the Lenin Academy of Agricultural Sciences, December 23, 1936, he said ('Agrobiology,' p. 160): 'In view of these unquestionable successes achieved by our science of breeding and genetics, many comrades, including some who are present at this session of the Academy, fail to understand the root causes of the controversy that is now going on in the columns of the magazines (Socialist Reconstruction of Agriculture, Vernalisation, etc.). Some of the participants in this controversy write in a rather high-handed style and, in my opinion, often go to extremes and try to twist the facts to suit their arguments. Nobody can accuse me of this.

'The controversy that has been and still is going on among us is not merely a conflict of opinion among individual scientists; it affects the most vital interests of research work.'

After some highly appreciative remarks on Darwin, Burbank and Thomas Hunt Morgan, he says there is a fundamental difference between these two trends in science (in genetics) which no agreement on minor questions can reconcile. And elsewhere he adds: 'I and those who think as I do stand by Darwin's theory of evolution, by Darwinism in all departments of agrobiological science. Hence we fundamentally disagree with those views on evolution . . . held by the school of N. I. Vavilov and by many geneticists.'

He was well acclaimed when he concluded his reply to the ensuing debate by saying: 'Can genetics be set up against Darwin's powerful creative theory of evolution? I think that under no circumstances can genetics be set up against Darwin's theory of evolution. Genetics must be developed only from the standpoint of Darwinism and on the plane of Darwinism. Only if that is done will our Soviet genetics be truly effective.'

The chairman and field agronomist of the V. M. Molotov Kolkhoz inspecting a wheat field

The Maltsev system

Further information on the Maltsev system of cultivation is contained in a recent article by Prof. P. A. Genkel (of the Timiryazev Institute of Plant Physiology) in *Vest. Akad. Nauk SSSR*. Maltsev's system not only raises the fertility of the soil and permits greater use of annual grasses, but also has other advantages; it is effective against weeds; the deep cultivated layer of soil formed by this method provides better supply of food and water; reduced number of ploughings lowers costs (fuel and labour).

Moreover it was found that the root system of plants was profoundly modified. In spring wheat the roots are mainly found in the upper soil layers (0-10 cm.), although there are also many fine rootlets at 40-50 cm. depth. But weight is of less importance than absorbing power. The total and active absorbing surface, as determined by Kolosov's method, was found to be much higher. Thus, wheat (Milturum 553) had a total absorbing surface of 0.97 sq. m. and active surface of 0.77 sq. m., *i.e.* from 20 to 40% greater.

The plants also have a more favourable water regime. Although this is often thought to make them more susceptible to drought, this was not now the case, for they showed enhanced drought and heat resistance.

For spring wheat Maltsev has suggested the use of two varieties; one early and the other late ripening, the former for late-starting spring weather and the latter for an early spring.

Great interest is being taken in Maltsev's new system throughout the Soviet Union and it is generally agreed that it has great possibilities. At the meeting held on Maltsev's collective farm (Kurgan region), delegates from Eastern Siberia, the Ukraine, Caucasia, etc., made several suggestions for its further development. It is important to note that the system must be applied differently for different soil and climate conditions. After viewing the experimental fields scientists and practical workers took part in discussion of the lectures delivered by Maltsev and others. The Director of the Kurgan Agricultural Institute testified that their own experiments had confirmed those of the innovator. They recognised in these proposals the elements of a new system of agriculture.

A new stage of development

Soviet agriculture, and more particularly the grain-growing regions of the Ukraine and North Caucasus, suffered tremendous damage during the war and by the severe drought of 1946—the worst in 50 years. It must be said at once that a remarkable and rapid recovery has been made. By 1952 the gross grain crop amounted to 128.5 million tons, or about double that of pre-Soviet Russia. In 1953 the area under cotton in the irrigated regions had been increased over that of 1940 by about 500,000 acres, and yields

per acre had markedly improved. The areas under sugar beet, sunflower seed and other industrial crops generally passed the pre-war level in 1950 or earlier, and production has been increasing since. Incidentally it is pointed out that, in comparison with other countries, the all-round development of the collective farm economy strengthen's the country's agriculture, with larger incomes for the Soviet peasants both in money and kind. ' In capitalist countries, as we know, the toiling peasants are losing their land and are being ruined. One million four hundred thousand farmers in the USA, *i.e.* 21% of the entire farming population, were ruined and had to abandon their land between 1935 and 1950.'

Inadequate production

Despite the progress recorded above it is still maintained that the level of agricultural production does not completely meet the country's demands for foodstuffs and industrial raw materials; the full possibilities are not realised and used; and development has to some extent lagged behind that of manufacturing industry. At a plenary meeting of the Central Committee of the Communist Party in September 1953, measures were decided for still further and more rapid progress. Collective and State farms are to be increased and better equipped, and machine and tractor stations in large numbers are to be provided. The sum of 15,000 million roubles was expended on these items in 1953, and a further 35,000 millions was allocated for 1954.

After some details dealing with advances in livestock farming the report continues with notes on mechanisation and crop yields. But it is of interest to note, in connection with livestock: ' In recent years 26 new highly productive breeds of farm animals have been raised by applying Michurin principles in livestock breeding and improving the feeding and housing of animals ' (Lysenko is a supporter of Michurin theory and practice).

Potato yields are to be increased by the application of better methods—the so-called checkrow (completely mechanised) planting, etc., summer planting, and the use of selected seed adapted to local conditions. It is said that it is possible to raise the yields from State and collective farms considerably, wheat already yields 25-35 cwt. per hectare and in some instances 40 cwt. Rice yields, *e.g.* in the Kazakh Republic, range from 51 to 100 cwt. or more; and high yields are also claimed in the Uzbek, Tajik, Azerbaijan and other rice-growing districts. Sugar beet is produced at the rate of 20-30 tons per hectare.

Despite differences of opinion among biologists practical work in seed breeding etc. appears to be progressive ; it is claimed that some 290 new kinds of higher-yielding crops, including 57 for wheat and 24 for oil-bearing crops, have been introduced into Soviet agriculture.

The report concludes with details of fertiliser manufacture and of increased supplies of tractors and other machinery.

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Photos : SCR

AFL 1081 and 1082

Following intensive research work by Associated Fumigators Ltd., two new fluoroacetate derivatives have been introduced; they are fluoroacetamide (1081) and fluoroacetanilide (1082).

$F \cdot CH_2CONH_2$ Fluoroacetamide AFL 1081

$F \cdot CH_2CONHC_6H_5$ Fluoroacetanilide AFL 1082

Fluoroacetamide is a white crystalline solid, m.p. 109°C., which is very soluble in cold water and which is a powerful rodenticide, being effective against rats, mice and rabbits. It has a lower toxicity than sodium fluoroacetate and its mode of toxicity is different from that of the sodium salt; the latter at its toxic dose causes violent convulsions in experimental animals, whereas the amide at its toxic dose, some two or three times that of the sodium salt, causes milder symptoms. It is, however, sufficiently active to be able to replace sodium fluoroacetate as a field rodenticide and gives a greater margin of safety in handling. It is probable that its rate of conversion into fluorocitrate is much slower than that of sodium fluoroacetate, so that the amount of the fluorocitrate, the real toxic product (Peters, *Endeavour*, 1954, p. 147), in the blood stream is minimal.

Fluoroacetanilide, AFL 1082, is sparingly soluble in water (about 1 part in 1,000 at room temperature) and is a low-melting solid (75-76°C.) which has contact, fumigant and systemic insecticidal action. It is to be introduced in the form of tablets for the latter purpose. It was discovered by Dr. M. A. Phillips, F.R.I.C., one of the original discoverers of M and B 693, and is fully protected by patents owned by Associated Fumigators Ltd.

African Locust Situation

Representatives of the French and Spanish governments met in Madrid recently to try and evolve a formula for co-operative action against the desert locust plague in North-West Africa.

The meeting, convened jointly by the Spanish Government and FAO, is of particular significance in view of the recent catastrophic invasion of French Morocco by desert locust swarms. In the space of a few weeks only damage to the extent of several million dollars was done in this area alone.

The calling of this meeting demonstrates the need to complete the 7,000-mile front against the present plague, operations against which are now in hand from the westernmost point of Africa through the Near and Middle East to India. A successful outcome of this meeting would extend real international co-operation, without which control is impossible, throughout the vast area so involved, and emphasises once more the value of FAO's co-ordinating role, which has hitherto been concentrated on the Near East.

The FAO delegation to the meeting included Dr. B. P. Uvarov, Director of the Anti-Locust Research Centre, London, and Mr. J. S. Hewitt, of the Desert Locust Control Organisation, Nairobi. Mr. Hewitt has recently returned from the most seriously affected area, which he visited as a result of an appeal to FAO by the French Government.

An Inside Look at the Soil

C. L. W. SWANSON*

In this article the author presents some interesting facts about the soil. It is important to realise that all soils are not alike. By making a study of the major types of soils we learn something of their make-up and properties and may eventually solve the problem of fixation of fertiliser elements.

WHEN most people think of soils, they visualise only the first 6 or 8 in., known as the plough layer. Some think only of the surface.

Soils do have depth, and their 'insides' vary tremendously from soil to soil. These variations are important in plant growth. We know, for example, that plant roots, especially those of trees and certain crops, penetrate the soil to considerable depth.

When you look at the soil to about a 3-ft. depth you soon realise that soils have their own special 'character.' They are usually made up of several layers or horizons. Each layer has a colour, structure, texture and organic matter content different from that of the other horizons. The sizes, amounts, and kinds of minerals and rocks also vary among the layers.

A typical soil is made up of sand, silt, clay and organic matter. Usually it contains about 50% air space, which is made up of the pores and spaces between the soil particles and aggregates.

Clay particle is small

Fig. 1, showing particle sizes, gives some idea of the relative size of the various fractions. On a comparative basis the largest sand fraction is no larger than the lead in a pencil. The clay fraction is much smaller and can hardly be seen in the illustration. Actually, a clay particle measures 8-millionths of an inch and smaller.

Organic matter, made up of dead plant and animal materials, is also found in varying sizes depending on how well it is decomposed. Clay-size organic matter is called humus. Amounts of organic matter vary in soils, with the average ranging from 3 to 5%.

To learn something useful about clays, one needs to take an inside look at them. Only then can we find out what really makes a soil 'tick.'

Clay is made up of extremely small minerals. Most of the clay minerals are particles ranging from 1-millionth to about 8-millionths of an inch in size. Because of their small size, clay minerals actually act like chemicals.

Clay and organic matter are the most important components of the soil because they play an active part in so many soil processes. They determine, to a large extent, whether or not you have a good soil for growing crops.

The clay fraction has what is known as the *exchange complex* of a soil. The amount of this material determines the soil's *exchange capacity*, in other words, its ability to hold and release such key plant-food elements as calcium, potassium and magnesium. When these elements are taken up by clays, it means that they cannot be leached readily from the soil. They are held in and on this exchange complex and are made available to plant roots as they are needed.

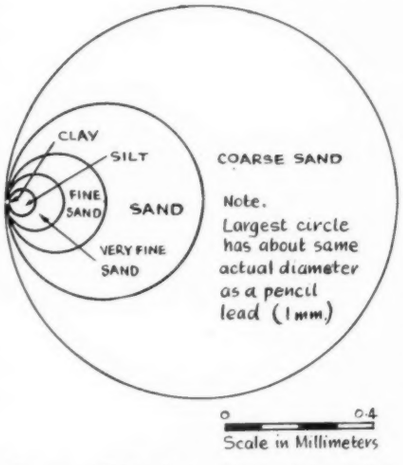

Fig. 1. Relative sizes of the different soil particles are shown here. Coarse sand particles reach the diameter of a pencil lead. A clay particle measures only 8-millionths of an inch or even smaller

The mechanism of how this occurs can be explained simply. Clays are made up of minerals of several kinds. Basically there are two groups of these minerals. All of them are more or less plate-like in nature, with some resemblance to stacked dinner plates.

Are accordion-like

Some of the clay minerals can expand and contract like an accordion. They expand when water is added, and they contract when dried out. One group of clay minerals does not have this ability to expand or contract and remains stationary. We call this the kaolinite type of clay mineral. The other major group, which takes up water and expands and contracts, is called the montmorillonite type of clay.

The chemical make-up of these major clay minerals is shown diagrammatically in Fig. 2. The montmorillonite group has a layer of silica, one of alumina and another of silica but kaolinite has only one layer of each. These clays are sometimes called 2 to 1 and 1 to 1 clay minerals because of the chemical arrangement of these layers.

These are new words—kaolinite and montmorillonite. Soil scientists are now using them in telling about some of their experimental results.

The space between the plates of the kaolinite type of clay mineral is about 10-billionths of an inch, but it does not have the ability to increase or decrease this space. The plate space in the montmorillonite type of clay minerals averages around 40-billionths of an inch and it can expand to about 80-billionths of an inch.

Can't get into particle

The diameters of small units of the various elements are not all the same. They vary in size—some are larger than others. For example, the potassium ion is 10.6-billionths of an inch in diameter, whereas the diameter of the calcium ion is about 8.5-billionths

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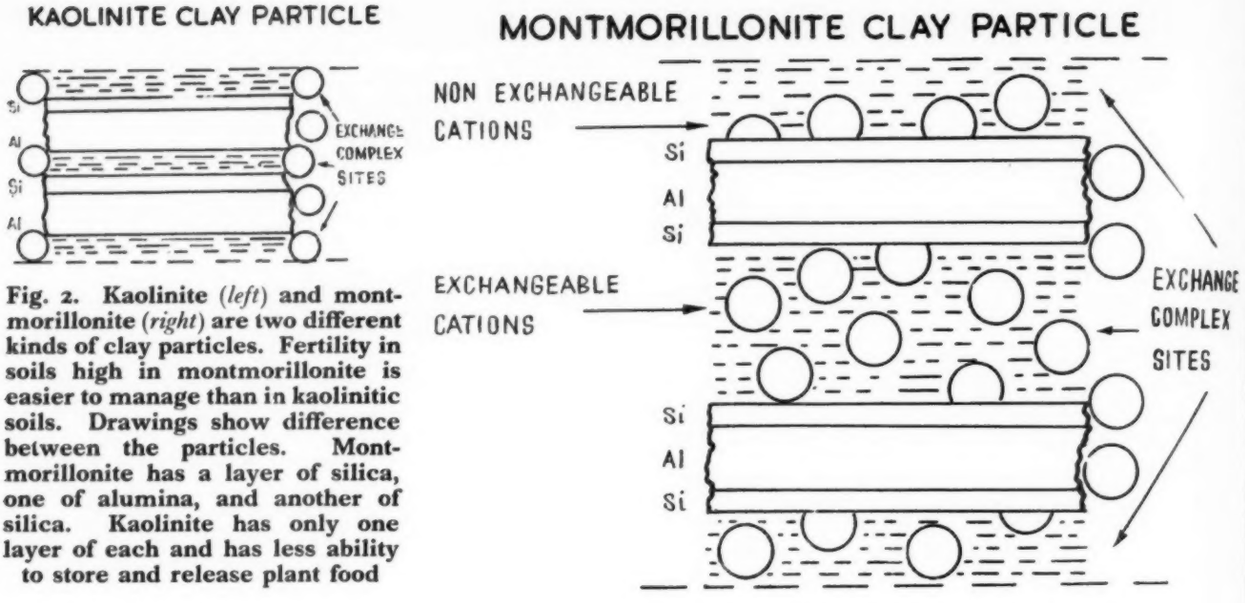


Fig. 2. Kaolinite (*left*) and montmorillonite (*right*) are two different kinds of clay particles. Fertility in soils high in montmorillonite is easier to manage than in kaolinitic soils. Drawings show difference between the particles. Montmorillonite has a layer of silica, one of alumina, and another of silica. Kaolinite has only one layer of each and has less ability to store and release plant food

of an inch. Although the calcium ion is smaller than potassium, calcium is always surrounded with tightly bound water. This causes the effective diameter of calcium to be greater than 8.5-billionths of an inch. It follows that, if the plates of the clay mineral do not open wide enough (see Fig. 2), certain ions cannot enter easily and thus be held in reserve. If not used by the plant immediately, they may be carried away through leaching.

Montmorillonite is useful

The montmorillonite type of clay mineral is the most useful in plant growth. Elements like calcium, magnesium and potassium are small enough so that they can fit between the plates of this kind of clay mineral. Attractive forces hold them between the plates strongly enough so that they are not leached out of the soil.

Some elements can stick on the outside of clay minerals due to the attractive forces of certain elements for each other, something like a magnet holds iron. These elements vary with the type of clay mineral, so some clays hold more magnesium, more phosphorus, or more potassium than others.

The element hydrogen has a ' toxic ' effect on the basic elements calcium, magnesium and potassium. It tends to push these elements out of the platey minerals. Growing plants give off carbonic acid, which contains hydrogen, thus providing a source of this element in the soil.

When hydrogen pushes out elements like calcium, magnesium and potassium, they are made readily available to the roots of plants. Consequently, it is not desirable that these elements be held too tightly by the clay minerals. Of course, when they are pushed out faster than the plant can use them, those fertiliser elements are leached out of the soil.

A very undesirable situation occurs when hydrogen entirely replaces the basic elements on the clay particles. The soil becomes acid and the basic elements are leached out. The usual way to avoid or remedy such a situation is to add lime. The lime will then replace most of the hydrogen, also making room for other elements like magnesium and potassium.

Some hydrogen needed

Since hydrogen serves a useful purpose in soils, we do not want to drive all of it out by making our soils alkaline. We keep our soils slightly acid so that some hydrogen will be available to perform its useful duties.

Montmorillonite clays may have about ten times greater exchange capacity than kaolinitic clays. They also have the capacity to hold several times as much water. Most of the soils in Connecticut, for example, have a predominance of kaolinitic clays and are, in addition, low in total amount of clay. That means that our soils are naturally low in fertility.

In Iowa, on the other hand, the clays are of a montmorillonitic nature, and the clay content is rather high. These soils are naturally fertile.

We increase the productivity of our soils by the use of fertilisers. In the case of kaolinitic clays, when fertilisers are added, the plant food elements, as for example phosphorus, are tied up so tightly that they are unavailable to plant roots. Also only small amounts leach out of the soil. But some of our soils are high in montmorillonite clay. These soils enable us to make maximum use of fertilisers in crop production.

What does all this mean? If we could learn more about what goes on in the soil when fertilisers are applied, it might be possible for us to make more efficient use of our fertilisers.

For example, it is often said that only 10 to 15% of our phosphatic fertilisers are used by the crop the first year. Possibly only 50% of the phosphorus is ever utilised, the remaining amount being tied up on the soil-clay complex. Another fertiliser element that becomes fixed rather easily and hence unavailable to plants is potassium.

How to untie them

If we could find how to ' untie ' or release soil phosphate and potassium, we certainly would be increasing the efficiency of our fertilisers as well as conserving our important natural resources. Untold wealth would be saved by the farmer in his fertiliser bill.

What we need now is more research to find out what really goes on in the soil when fertilisers of various kinds are applied. Much of the work to date on fertilisers has had to do with applying them on a field basis. This has been useful work, but it doesn't provide answers to fundamental problems. For example, the phenomenon of how ions like phosphorus and potassium are tied up in the soil is not well understood.

If the physical and chemical action of minerals were well known, useful solutions to the problem of fixation of fertiliser elements would become available.

One approach is to study the soil-clay complex. One of the first steps along this line is to realise that all soils are not alike. By studying the major kinds of soils, we learn something about their make up and their properties.

On the surface, solution to this problem may appear simple. But many kinds of research tools and much hard work will be required before the desired answers are obtained. The use of radio-active minerals, *X*-rays, atomic knowledge, and other modern techniques will help us to reach our goal.

Reprinted from *What's New in Crops & Soils*, **6**, 1954, No. 9.

Barley as an Irrigated Crop in Iraq

Continued from page 239

the pumped water is lifted. Statistics show that lift irrigation is applied to nearly 3 million acres, largely on the higher terraces of alluvium within a few miles of the main river bank. The number of pumps installed is close on 6,000, with an average horsepower of 35, all running on diesel or kerosene which are produced cheaply by the Iraq Petroleum Co. The water distribution efficiency works out at 14 acres per horse-power, but half of the land is, of course, under fallow all the time. The barley yield from this kind of land is considerably above the average.

The water requirements for barley are stated to be 3 in. depth every 21 days, giving eight or nine irrigations during the six winter months, November to April, but nowhere is there any record of accurate water-use measurements, and the average single application by the cultivators is certainly well above 3 in. of water. Economies in watering can, of course, be secured by decreasing irrigation during and after the heavier winter rain storms.

The traditional supply of water is at the rate of 19,500 mesharas (11,730 acres) for every cu. m. per second of water delivery, but in the canals now being planned it is hoped to introduce more intensive cropping with cotton and vegetables on part of the land during the summer. For this a duty of 12,000 mesharas (7,200 acres) per cumec is to be provided at the main canal outlet. Seepage and evaporation losses between the main canal and the field are therefore included in this figure.

Refrigerated Store for Citrus Juices

Claimed to be one of the largest of its kind in the world, a new refrigerated warehouse has recently been taken into service by the Pasco Packing Co., Dade City, Florida, for the storage of fresh-frozen citrus concentrate.

Lying to the east of Dade City is an area now noted for its well-planned and symmetrical groves of grapefruit, orange and tangerine trees. Oranges were introduced into Florida by the Spaniards in the 16th century and flourished in a wild state till the end of the 18th century. At that time the first commercial planting took place near Safety Harbour in Pinellas County and by 1895 some 6 million boxes of fruit were being grown each year. A hard frost in 1896 so seared the groves, however, that it took a decade to reach that production figure again, but such has been the rapid development of the industry since 1910 that production is now in the region of 120 million boxes annually.

When production outstripped the demand for the fresh fruit, the surplus was canned in pasteurised concentrate form, but still there was a surplus from the expanding groves and in 1948 the Pasco Packing Co., who now process about 18% of the Florida citrus crop, decided to convert their pasteurised concentrate equipment to produce fresh-frozen concentrate, which is now also being sold from counter dispensers in individual portions.

In addition to canning citrus juices, concentrates and fruit sections, Pasco processes the citrus peel for cattle feed and extracts essential oils, vitamins and other by-products.

Since making the concentrate covers only eight months of the year, it was necessary to provide suitable refrigerated storage for much of the company's production, and the new warehouse has been designed to meet this need. With a total of 2½ million cu. ft. of space and a storage area of 100,000 sq. ft., the new facility will store 2½ million cases of concentrate, packed and ready for despatch. This represents 5,625,000 gal. of juice, or 833 refrigerator-car loads, and is about one-half of Pasco's output.

The storage area is divided into four rooms, insulated with fibreglass and vapour-barrier paper, in each of which is installed two Niagara 'No-Frost' spray coolers, each with a capacity of 24,000 cu. ft. of air per min. and 30 tons of refrigerated material at −15°F. The units include flooded ammonia coils with float valves, accumulators and piping, and each cooler is fitted with a 10-h.p. fan motor and a 1-h.p. totally enclosed pump motor. No ducts are required to distribute the air throughout the room. The two coolers are placed back to back on a common platform mounted over the working aisle. This location is ideal because the units do not take up any working or storage space.

Four electric concentrators mounted in the machinery room away from the refrigerated areas take care of condensate-water removal from the refrigerating liquid. Automatically controlled, each has a capacity of 6 gal. per hour.

Four Frick ammonia-compressors, together with companion booster compressors, produce the required tonnage of refrigeration, which can be regulated in 10 steps of capacity ranging from 35 tons to 265 tons.

To provide speedy access to the warehouse from the packaging plant, which is on the other side of a double main-line railway track with sidings, a 12-ft. diameter, 225-ft. long tunnel has been driven from a 14-ft. diameter shaft near the packing machines. A similar outlet shaft is located inside the sub-zero storage warehouse.

South African Agricultural Developments

From our South African Correspondent

THE drought in the Orange Free State and other parts of the country will probably reduce this year's maize crop by about 8 million bags.

Forty million bags were produced last year but only about 32 millions are expected this year. South Africa used about 26 million bags a year, so that 6 million bags are expected to be carried over for export as well as last year's stocks now in hand. The export market has remained stable because of the poor Argentine crop, so that no difficulty is expected in selling South Africa's surplus stocks at good prices.

The U.S.A. has plenty of maize, but sellers do not fear a lowering of the price from that source. At the same time it is noted that 10 million bags of maize may have to be stored in the open for 12 months or longer, largely because of the railway's inability to shift maize for export at the necessary speed. So great is the stock of maize remaining after two record crops that the carry-over in May will be about 12 million bags worth nearly £20 million. If continuing heavy rains do not damage the new crop, there will be a further surplus. Now the Maize Industry Control Board is warning farmers that they must deliver the new crop—due from April onwards—in new bags only. Holes, patches, darns or even stains, will not be permitted. Maize stored in the open must be in the strongest bags available. It will not accept maize in the Transvaal, Orange Free State, Mafeking or Vryburg districts unless they are in heavy bags that comply with this standard.

Grapes

Export grape farmers in the Hex Valley face disastrous losses as a result of the unseasonable heavy rains in February. They say the bulk of a promising export grape crop was ruined because the rain saturated the bunches and caused the grapes to burst. A big tonnage of what would have been top-quality export grapes were sent to the pressing vats in the wine cellars. The rains came at a stage when most farmers had hardly started packing their export grapes in earnest and when only a fraction of the exportable tonnage from the Hex Valley had reached the docks. Large-scale growers lost heavily because of the Deciduous Fruit Board's injunction to stop picking and packing for two days.

Citrus

Financial results of the 1954 export season of citrus fruit are not yet available. There are indications, however, that the rise in the quantity shipped, from 5,257,101 cases in 1953 to 6,419,824 cases during 1954, will be accompanied by a roughly proportionate increase in revenue over the 1953 total of £9,731,000.

Wheat

The 1954-55 wheat crop is finally estimated at 5,896,000 bags of 200 lb. by the Division of Economics and Markets of the Department of Agriculture. According to a revised estimate by the Division, last season's crop was 6,347,000 bags. Figures (in bags) for the various provinces, with the previous season's crop in parentheses, are: Cape Province 3,673,000 (4,041,000); Transvaal 626,000 (638,000); Orange Free State 1,597,000 (1,668,000). Total 5,896,000 (6,347,000).

Tea

Tea prices in South Africa have been rising and threaten to rise still higher. This is increasing the local consumption of bush tea (*rooibos*), which retails at less than half the price of Indian teas. This *rooibos* is available in a number of varieties, one of which was registered in November with the Department of Agriculture as a farming product.

This wild bush growing in the Clanwilliam and other areas yields a brew similar to tea. In recent years the *rooibos* has been cultivated and the quality steadily raised. During the present year the Clanwilliam *rooibos* tea industry expects to sell 1.5 million lb. In the old days the bush tea had to be boiled for some time to bring out the flavour, but today the bush tea is made in the same way as Indian tea, except that it is allowed to stand longer. It is claimed that bush tea is lacking in the alkaloids present in Indian and China teas, and thus when it is made with hot milk it has no harmful qualities. There has been little export of the *rooibos* tea, but people who have lived in South Africa for some time and acquired a taste for it often arrange for regular consignments to be sent to them. It is possible that the local industry will in the future seek to develop a taste for the tea in other countries so that export markets can be developed. Normally the tea crop is picked in the Clanwilliam district in the first three months of the year and processed, dried, and sifted to extract the dust.

Particular attention is paid to the blending, which yields the high-quality product now doing so well on the South African market. Coloured workers from mission stations and other places usually work in the bush-tea industry at this period. The tea is in the form of small sticks rather than leaves. Thus it is not the practice, as in Ceylon and Assam, merely to pick the top leaves and buds but to remove all the young shoots from about 2 in. above the previous year's growth. These green twigs are put into hessian bags, which are later collected by lorry and taken to the packing sheds. There the twigs go through the cutting machines before being bruised and fermented. The soil in which bush tea is grown influences the flavour of the tea. High growing areas give a tea of reddish tint after fermentation. Tea from lower districts is black.

Tomatoes

A devastating outbreak of Irish blight, which is wiping out tomato crops by the morgen, has cost Eastern Cape farmers tens of thousands of pounds besides causing an acute scarcity of tomatoes and forcing up prices to nearly double. The disease, which first appeared in the Eastern Cape in a mild form about four years ago, has begun a reign of terror in which many farmers are losing whole crops of tomatoes—their main source of income. With lightning swiftness the blight attacks a crop just as the fruit is ripening. Within three or four days the tomatoes have gone black and dropped off, and the vines have withered.

Farmers in the Strandveld, between Port Elizabeth and the Gamtoos River, the biggest tomato-producing area in the Eastern Cape, who usually have large crops in the late season, have done badly. Incomes from tomatoes have in some cases dropped from £2,000 to less than £50 a year. Some of the farmers have abandoned tomatoes in favour of chicory and it is said locally that there was no effective cure for the disease.

Copper sulphate was used to dust on the crops, but a shower of rain would wash it off, and often before a farmer had had time to dust the crop again Irish blight had struck. Tomato farmers in other parts of the Union are not at present afflicted in this way. In Cape Town and Johannesburg tomato supplies have been good and prices reasonable.

49 Nations Joined in Forest Congress

The fourth World Forestry Congress at Dehra Dun, India, from December 11 to 22 was attended by 380 forestry technicians from 49 countries, who were the guests of the Indian Government.

The general theme of the congress was the place of the forest in the development of countries and their land economy.

Under this heading it covered, in its world-wide aspect, both the protective and the productive functions of the forest and the necessity for rational utilisation of forest products. Finally, as it had been decided to merge the proposed Tropical World Forestry Congress with the fourth World Forestry Congress, the Dehra Dun meeting went into the choice of a policy for tropical forests.

The most important part of the discussions on tropical forestry was devoted to heterogeneous types of forest. It was recognised that research on the silviculture of these types needed to be properly organised and was suggested that FAO and the International Union of Forest Research Organisations should undertake the drafting of a normal pattern for such research.

It was, however, also recognised that the backwardness of the research and of silvicultural techniques used in such types of forests was partly due to the lack of a definite policy for heterogeneous forests. Whereas some foresters look for an improvement in quality and homogeneity of the stands through gradual replacement with fewer species which will not disturb the ecological equilibrium of the forest, others advocate more radical and rapid operations, and even clear cutting of the forest and replacement of the stand by pure plantations of fast-growing species. The congress studied this choice between either growing the timber required for industry or adapting the industry to the timber grown and formulated a set of principles on the development of this very important type of forest.

Other questions of great importance for tropical forestry which were discussed included statistical methods of research, inventories and shifting cultivation. Much attention was also paid to the problems of arid and semi-arid regions, and the congress suggested the organisation of an 'International Commission on Desert Control and Arid Zone Forestry,' which would work in close liaison with UNESCO, since this organisation has already set up various bodies carrying out basic scientific work in such regions.

In its discussions of overall policy for the world's forests, the congress agreed that in many areas the protective role of the forest was irreplaceable, and that in others it constituted the only possible economic use of the land. In all other cases, however, the extent of the forest must depend on the degree and the kind of development of a country's economy, on the development of its agricultural and soil-conservation techniques, and on its social requirements. It was also recognised that, apart from its protective role, the forest could play an active role in economic development only if it was correctly managed for sustained yield (taking into account the possibilities of multiple use), and if its products were harvested and converted rationally into useful products.

These considerations led the congress to review the status of forest management in various fields: for wood and timber production, grazing, wild life and recreation. The importance was emphasised of trees and plantations 'outside the forest' for both protection and production. Deficiencies in research and techniques in these various fields were mentioned and steps suggested for remedying them, as also in respect of the development of efficient forest industries, integrated with the forests from which they draw their supply. An important suggestion with regard to the conservation of natural resources was for FAO to study a set of principles of soil- and water-conservation policy to be submitted for the approval of all countries so as to impress on all governments the importance of their responsibilities in this field.

Several committees were set up during the congress to study various problems indirectly related to its general programme. One of these reviewed the work already done by the joint FAO/IUFRO Committee on Bibliography. It urged, as already recommended by FAO and IUFRO, the adoption by all countries of the new 'Oxford Decimal Classification System' for forestry bibliography. The committee itself, with the help of the Commonwealth Forestry Bureau, will undertake the production of a multilingual forestry dictionary, a work which was advocated by the third World Forestry Congress. The general lines of the proposed procedure for such work were approved by the congress, and the most urgent step is now the setting up of terminology committees in all countries.

To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books and have a world-wide selling and distributing organisation.

NEW BOOKS

Engineering in Agriculture

By P. H. Southwell. Pp. xii + 260, illustrated. London. Temple Press Ltd. 30s.

This book satisfies a need which, as a result of the mechanical revolution in agriculture, has become increasingly pressing during recent years. The successful agricultural engineer, and even the farmer, is daily required to understand the first principles of mechanics, electricity and hydraulics and, furthermore, must be able to spot the occasions when application of this knowledge is required.

Mr. Southwell is to be congratulated on enabling the reader to satisfy both these requirements. The early chapters provide essential basic data and knowledge usually found only in separate textbooks on mechanics and mechanisms, structures, hydraulics, electricity, surveying, and the strength and properties of materials. The first principles are then simply developed until their application to agricultural engineering questions can readily be seen and understood and many pertinent specific examples are given.

The tables and definitions in the appendix are a useful selection and are set out for quick and easy reference; included, for example, is a list of the drawbar pull requirements for various implements in a medium soil.

The oversea agricultural engineer, far removed from normal reference channels, will be particularly grateful that Mr. Southwell has now reduced his library of textbooks from some half-dozen volumes to one comprehensive book.

D. MANBY

50 Years on Tracks

Caterpillar Tractor Co., Peoria, Ill., U.S.A. Pp. 104, illustrated. 1954. $1.25.

The Caterpillar Tractor Co. has recently added its story to the rapidly growing list of corporate histories.

This book was produced by Caterpillar as part of the programme conducted during 1954 to mark the 50th anniversary of the crawler tractor, of which the first practical type was manufactured by the Holt Manufacturing Co. in 1904. It was written and published by the company and its layout is unconventional, for its story is presented in the form of a series of separate chronological essays.

Perhaps the most unusual feature of the book is its photographs, most of which were selected from the company's files. Some are more than 60 years old and show the huge combine harvesters and steam tractors of the 1890s at work. One of the steamers pictured is almost 60 ft. wide.

The book begins with these combines and tractors that preceded the first crawler of 1904; later, each important step of the crawler's evolution is traced photographically. Along with machinery advances, the growth of such markets as agriculture, logging and the oil industry also receive attention.

Only the first three-fifths of '50 Years on Tracks' covers Caterpillar's history; the remainder presents the manufacture as it is today. Writers employed the case method and the reader follows the manufacture of one product, one research project, one supplier, one customer, etc.

In offering this cross-section of Caterpillar's operations, the book affords a clear glimpse at the workings and characteristics of the entire industry.

Plantation Crops

A review of production, trade and consumption relating to sugar, tea, coffee, cocoa, spices, tobacco and rubber, with appendices. London. H.M.S.O. 1955. 5s.

Plantation crops—sugar, tea, coffee, cocoa, spices, tobacco and rubber—include the main products of many Commonwealth countries and are in some cases among the major dollar earners of the sterling area. The large proportion of total output which enters international trade emphasises the significance of external factors to the economy of producing countries. The Commonwealth Economic Committee, in its latest annual review, 'Plantation Crops,' shows the effects of these various factors on world markets in recent years.

Sugar and cocoa showed a substantial expansion in output in 1953. Production of sugar was at a record level, nearly 40% above the pre-war average, that in Australia being particularly large, and the recovery in cocoa output in the Gold Coast contributed largely to the higher world total. Production of tea and tobacco, although substantially greater than before the war, showed little increase over 1952 (despite the record tea crop in Ceylon), and that of rubber—some two-thirds above the pre-war level—fell slightly. Output of coffee was virtually unchanged at close to the 1937-39 average. The Commonwealth continued to produce the bulk of the world's tea, nearly half of its rubber and half of its cocoa. For tea and rubber, as for sugar, Commonwealth output in 1953 was nearly half as great again as before the war, and its production of tobacco, although still below the pre-war level, showed a recovery.

Plantation crops continue to find their chief export markets in the U.K. and the U.S.A. In 1953 the U.K. was again the largest importer of tea and tobacco; the U.S.A., which is the world's largest exporter of tobacco, was also an importer almost as large as Germany or the Netherlands and was second only to the U.K. as a market for tea, although *per caput* consumption was under ¾ lb. a year. As before the war, the U.S.A. is the principal importer of coffee, sugar, cocoa and rubber, with the U.K. the second most important outlet for all except coffee.

The U.K. drew from Commonwealth sources well over nine-tenths of its tea, cocoa and rubber in 1953—the proportion of tea and rubber so taken being higher than before the war; with a reduction of imports of coffee from foreign sources the share taken from the Commonwealth rose to nearly three-quarters, and for tobacco, although supplies from the U.S.A. were larger than a year earlier, the Commonwealth proportion was two-fifths, as compared with about one-quarter before the war. The share of the U.K. sugar imports supplied by Commonwealth producers continued to increase in 1953, despite heavy shipments from Cuba in preparation for derationing, but the proportion was less than the pre-war figure of over one-half. The relatively small U.K. imports of pepper, cloves, ginger and other spices are mainly from Commonwealth sources.

Consumption of sugar, tea, cocoa and coffee rose in 1953 in several of the

main consuming countries—substantially so in the U.K. for the three first-named commodities. The demand for sugar in the U.K. showed a marked increase, rationing coming to an end in the latter part of the year, and consumption of tea, at 9.4 lb. per head, exceeded the pre-war level; the decline in the consumption of coffee continued, although at 1.6 lb. per head this was still twice as great as before the war. In the U.S.A. coffee consumption remains at some 16 lb. per head, but the gradual increase in the demand for tea became more marked in 1953; in Canada, where the consumption figures for coffee and tea were very similar before the war, total consumption of the former has more than doubled, while that of tea has not kept pace with the increase in population. Cocoa consumption showed a recovery in 1953, not only in the U.S.A. and the U.K., but also in Western Europe and in oversea Commonwealth markets; the level of tobacco consumption, however, showed no marked change during the year, although cigarettes continued to gain in popularity at the expense of pipe tobacco. The offtake of natural rubber in the U.S.A. and the U.K. recovered in 1953, as did that in the industrialised countries of the Commonwealth, in Japan and in some countries of Europe; consumption of synthetic rubber, however, declined in the U.S.A., the main market.

The appendices dealing with international agreements, and with Government measures and import duties in certain countries, have been brought up to date and a new appendix on export duties and cesses has been added.

REPORTS and PUBLICATIONS

Annual Report of the Malayan Department of Agriculture for 1953

A report dealing with most aspects of agriculture in the Federation of Malaya. Included is a statement of Government policy and a section summarising recent agricultural legislation.

Publications of the Ministry of Agriculture, Sudan Government

'The Zande Scheme' and 'Notes on Cotton Growing from the Research Division' are the titles of Bulletins Nos. 14 and 15 respectively. 'The Zande Scheme' is a revision of the article originally published in the *Empire Cotton Growing Review*, **26,** No. 2, 1949, and deals mainly with the agricultural aspects of the scheme.

'Hafirs or Development by Surface Water Supplies in the Sudan' is the title of Memoirs of Field Division, 1954, No. 7, and Memoirs of Research Division, 1953, No. 43, is entitled 'Agronomic Research on Cotton in the Sudan Gezira.'

Empire Cotton Growing Corporation—Progress Reports from Experiment Stations, 1953-54

These reports are concerned with progress in the Aden Protectorate, Nyasaland and the West Indies. The Cotton Research Station at Namulonge, Uganda, is the subject of two publications.

Tiv Farm and Settlement

This, a monograph published by H.M.S.O., is the record of an ethnographic research in the Tiv district of Nigeria. The author, Mr. Paul Bohannan, has made three trips to the Tiv area and the material in the monograph is the result of much painstaking work.

An Energy Survey in the Somaliland Protectorate

This survey was made in 1954 and suggestions are made for the utilisation of natural energy resources, including wind power and solar radiation. It is published by the British Electrical and Allied Industries Research Association.

Pea Growers' Handbook, 1954

A short booklet published by the Home Grown Threshed Peas Joint Committee, London. Many of the facts presented are the result of widespread field experiments and the remainder are founded on the experience of experts upon whose judgment reliance can be placed.

African Soils

We have received the latest issue of this bilingual magazine (Vol. 3, No. 2). It is the periodical bulletin of the Inter-African Bureau for Soils and Rural Economy and is intended for the use of all persons or organisations—specialists, research organisations, official services, etc.—that are endeavouring to arrest the degradation of the soil in Africa and to promote the adoption there of agricultural methods based on principles of soil conservation. An article of particular interest is entitled 'Scheme for the Improvement of the Agricultural Economy of Senegal'; it is concerned with the selection of an agricultural system, the selection of a production system, the general organisation of production and financing the operations required by such organisation.

Redistribution of Farmland in Seven Countries

The *International Journal of Agrarian Affairs*, **2,** No. 1, 1955, has this overall title for a series of articles dealing with this problem. The countries involved are, in order of mention, Finland, Guatemala, Israel, Italy, Puerto Rico, Syria and Yugoslavia. The journal is published by Oxford University Press (London: Geoffrey Cumberlege, price 5s.).

The Journal of the Royal Agricultural Society of England, 115, 1954 (including Royal Show supplement). Pp. xlvi + 288, illustrated. London: John Murray. 20s. to non-members

The latest edition of the *Journal of the Royal Agricultural Society of England* continues to maintain the high standards evidenced in earlier volumes.

The special articles include a collection of five contributions under the general title 'Some Aspects of East Midland Agriculture,' which deal with agricultural practice in Nottinghamshire, Derbyshire, Leicestershire and Lincolnshire (Kesteven). Together these counties cover 2,168,720 acres, of which 1,355,879 acres are used for food production (1953 figures).

Other general articles include 'Recent Advances in Conservation of Forage Crops,' by G. W. Cooke and H. V. Garner, of Rothamsted; 'Soil-Borne Diseases of Cereals,' by Mary D. Glynne, of Rothamsted; 'Three Im-

portant Pests of Cereals in Britain,' by Herbert and Mary Miles, of Wye College; 'The Development of Potato-Growing in Lincolnshire,' by J. C. Wallace; and ' Virus Diseases and the Fruit Farmer,' by R. V. Harris, of East Malling Research Station.

A substantial part of the volume is taken up with ' The Farmers' Guide to Agricultural Research.' This section is widely known and, as usual, contains many valuable contributions. Dr. C. S. Orwin again writes on farm economics, Dr. E. W. Howards on plant breeding, Dr. E. W. Russell on soils and fertilisers, Mr. S. J. Wright on farm machinery, Dr. John Duckworth on feeding of livestock, Mr. A. W. Stableforth and Mr. J. L. McGirr on diseases of animals, and Mr. James Mackintosh contributes an article on dairy farming. All these authors are acknowledged in their specialised fields and their contributions constitute a permanent record of agricultural advances in the year under review.

Artificial Lighting for Plant Growth, by A. E. Canham, M.SC., Technical Report W/T31, The Electrical Research Association

Light is one of the major factors controlling plant growth. By the appropriate use of artificial light greater control over the growth and development of plants is possible. It is a complex subject and in this paper the effects of different light conditions are discussed. Applications of artificial light in research and commercial horticulture are also considered, together with the merits of different light sources for these purposes.

Food and Agricultural Price Policies in Far Eastern Countries with special reference to rice, Part 1, United Nations Organisation

The report of the 11th session of the Economic Commission for Asia and the Far East which was held in Tokyo, Japan, March 28 to April 7, 1955. This is a limited document showing the work undertaken in accordance with the work programme of the Joint ECAFE/FAO Agriculture Division approved by the Commission at its 10th session. It will be published in two parts. The first part, which has been prepared at FAO Headquarters, Rome, with the assistance of the Joint ECAFE/FAO Agriculture Division, gives an overall review of the situation in the Far East region as a whole, with some broad comparisons between a few individual countries. Although price policies for basic foods in Far Eastern countries have recently been modified in many important respects, they still largely reflect the influence of the long post-war shortage during which they were developed. The present paper reviews the gradual development of these policies on the side of production and consumption during the period of shortage and in the very different conditions of 1953 and 1954. It also attempts to appraise some of the main results of these policies and to discuss some of the problems which seem likely to arise in the near future.

FAO Publications

Activities of FAO under the Expanded Technical Assistance Program, 1953-54 was published this year. The development of the Technical Assistance Programme, and the continued interest and enthusiasm which it arouses, are in themselves a great achievement, for it is only by the mutual energy and enthusiasm of both the major contributing and recipient countries that the aims embodied by the founders of the Programme will be realised in the coming years.

Handling Forest Tree Seed is a book published in Italy by Stabilimenti Tipolitografici Vallecchi. It deals with: (1) Methods of handling forest tree seed, from procurement to packaging. (2) International rules for testing seed of forest tree species. It deals also with the technical matters involved in collecting, extracting, cleaning, testing, storing and shipping tree seed, as well as with the practical arrangements for promoting exchange and international trade in trees among the various co-operating countries.

Problems of Food and Agricultural Expansion in the Near East. During the 7th Session of the FAO Conference held in Rome in November 1953 delegates representing 71 countries paid special attention to the existence of surpluses of certain agricultural products in some areas, side by side with the persistence of very inadequate nutritional levels in other areas. The conference recommended that intergovernmental consultations on a regional level on the problems of selective expansion of production and consumption be held in 1954 and 1955. The Near East meeting was the first of the consultations.

FAO Fisheries Bulletin, 8, 1955, *No.* 1, deals with *Tilapia* and its culture. One of the purposes of this booklet is to assist in the task of selecting appropriate species for introduction into natural inland waters and artificially retained waters—a task which should include the comparison of various species of fish, including those of the genus *Tilapia.*

Monographs on Tea Production in Ceylon, No. 3, Organisation of Tea Research Work in Ceylon

The report is published with the permission of the Board of Control of the Tea Research Institute of Ceylon and deals with the obvious and urgent need for sound long-term planning of the affairs of the Institute. The complexity of a research organisation is not generally appreciated and interference with the Board of Control and the administration, who are responsible for long-term planning as a whole, by parochial or political associations with narrower short-term interests, can only lead to confusion. The report closes: ' In the fewest possible words, the plea of the Tea Research Institute to the industry and to the Government must be: " Indicate to us the problems you wish us to investigate, give us the necessary tools, but let us do the job in our own way".'

Annual Report of the Department of Agriculture and Veterinary Services of the Somaliland Protectorate, 1954

In the Somaliland Protectorate the urgent need for qualified staff and the talented technician became more than ever apparent during the period under review. Indeed, it is no exaggeration to say that funds for balanced agricultural development were available, but there was no competent staff to administer them. For a year the Protectorate, which is dependent on livestock and livestock products for its meagre revenue, was without a qualified veterinarian. The Date Introduction Scheme, which has for its target the self-sufficiency of the Protectorate in dates—in 1953 the date importations were valued at £183,000—has now been without the guidance of a qualified agronomist for well over a year.

FARM MACHINERY

Tractor-Mounted Skips

Arley Fabrications Ltd., Manchester, have announced that they are now producing two skips for farm use. The 'Farm-Skip' can be attached and removed easily by one man in a few moments without the use of any tools and is the ideal general-purpose unit for every farm with a tractor. It gives easy access to cow stalls and will convey a variety of loads, such as meal, water, root fodder and pig food. A safety device is provided to guard against accidental tipping of the skip.

The body is constructed of prime-quality $\frac{1}{8}$-in. mild-steel plate, reinforced and finished both inside and out with a first-quality hot-dipped galvanised-zinc coating; an additional coat of paint is given to the outside. A stopcock is fitted to a $1\frac{1}{2}$-in.-dia. outlet and there is an attachment plate for the acceptance of any standard hand-operated semi-rotary pump. The lid is of steel and galvanised inside and out; it is painted outside for added protection and easy cleaning, and is fitted with a filler port, four quick-action clamps and a non-leak lid seal. The capacity is 11 cu. ft. (approx. 70 gal.).

The 'Mix-Skip' is designed to carry quickly and easily such materials as concrete, sand, plaster, rubble, cement, soil, etc. It is fitted with a quick-release mechanism, which enables the driver to tip his load without moving from the tractor seat.

The body is constructed of prime-quality $\frac{1}{8}$-in. mild-steel plate, reinforced on the back face and painted inside and out. The capacity is 11 cu. ft.

The frame for the Arley skips is common to both types and is produced from prime-quality material. It is of welded-steel construction with painted finish. The unit, which comprises the frame and the body, is supported on the three-point linkage and does not require the use of hydraulic power. This, as will be readily appreciated, is a distinct advantage, as other equipment requiring this need not be affected. The frame and the body can be assembled or dismantled by one man in under a minute and the complete unit can be attached to, or detached from, the tractor by one man in under five minutes.

The Arley 'Farm-Skip' mounted for use. A universal carrying implement

Although the unit is tested to carry 3,000 lb., loads in excess of 1,000 lb. are recommended only if tractor front-end counterbalance is used.

A 90-gal. galvanised tank complete with tap is also available. It is fitted by one man in under two minutes to the standard frame and is so mounted as to permit the safe carrying of the full capacity without front-end counterbalance. Bodies and tanks can be supplied with a special finish to comply with regulations for milk containers. Acid-resisting finishes are also available and to suit customers' requirements. Tank weight 180 lb.; $1\frac{1}{2}$-in.-dia. outlet with stopcock. An attachment plate is fitted for the acceptance of any standard hand-operated semi-rotary pump.

Note the thickness of many of the stumps, which were cut down and chopped up by the 'X'-type trailing rotavator. The model seen in this picture (taken near Leatherhead, Surrey) had a special rear shield designed for forestry work

Cambridge Company at Salon

Fisons Pest Control, the British agricultural chemical company which has its headquarters near the university city of Cambridge, was represented on one of the machinery stands at the Salon Internationale de la Machine Agricole in Paris.

In the unceasing battle of science against weeds, insect pests and plant diseases Fisons Pest Control uses equipment ranging from aircraft to the neat attractive 'Pesco' knapsack sprayer. This sprayer, together with the 'Pesco' gun, was seen on the Sotec stand, accompanied by the latest ground-spraying machine, the 150-gal. 'Fieldmaster,' which made its debut at the Smithfield Show in London.

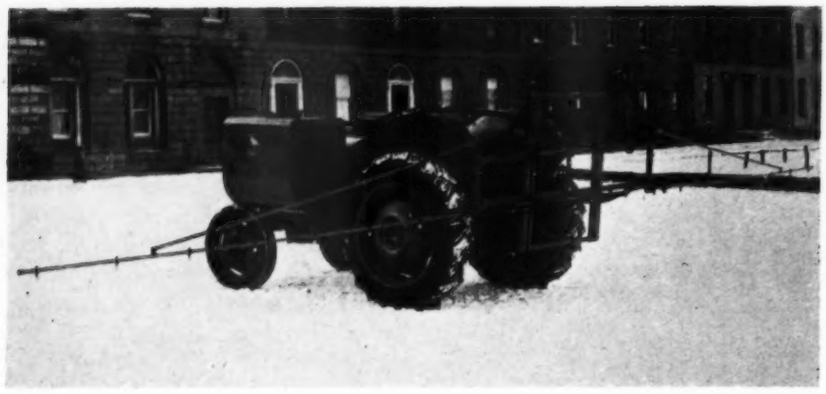
The new 'Fieldmaster' is designed for medium-pressure spraying at high or low volume and is suitable for use with most kinds of tractor. Its tank is carried on a sturdy chassis and is equipped with a mechanically driven agitator. The 'Arun' pump operated from the power take-off delivers 15 gal./min. at 200 lb./sq. in.

Other advantages of the 150-gal. 'Fieldmaster' include three-stage filtration, adjustable track width for row-crop work, and interchangeable nozzles giving an application rate of from 5-80 gal. per acre at four miles an hour.

X-Type Trailing Rotavator for Forestry Work

The X-type trailing rotavator was demonstrated recently on Forestry Commission land near Leatherhead, Surrey, as a tool for clearing scrubland for replanting. The model demonstrated had a special rear shield designed for forestry work.

X-type Howard trailing rotavators are suitable for tractors in the 80/120-b.h.p. range. Cultivating width is 96 in. Depth is adjustable to a maximum of 12 in. in most soils.



The Dorman Ferguson or Fordson Major mounted 120-gal. saddle tank low/medium-volume sprayer with 30-ft. booms open

Dorman Sprayer

The new Dorman 120-gal. saddle tank low/medium-volume sprayer suitable for mounting on the Ferguson and Fordson Major tractors is being well received by the larger farmers and spraying contractors for the application of selective weedkillers, insecticides and fungicides to growing crops.

The prototype models were very thoroughly field-tested last season under widely varying conditions and modified forms of this machine have been successfully used in the Sudan during the past three years.

The sprayer has a shock-absorbing sprayboom giving a 30-ft. cover and is mounted on a boom guide designed for a wide range of height adjustment to suit many types of crop. The two 60-gal. tanks mounted on either side of the tractor engine are held in position by a sturdy longitudinal channel steel frame which runs to the rear of the tractor and also supports the boom and guide. Fitting is simple and parts are reduced to a bare minimum for ease of assembly.

The $1\frac{1}{4}$-in. gear pump is of bronze and stainless steel construction and supplies the nozzles for applications of 5, 10, 15, 25 and 50 gal. per acre. Rates of application are altered by changing the nozzle tips and are all obtainable at 5 m.p.h. and 40 lb./sq. in. If greater applications are required, the 50-gal./sec. tips are fitted and the tractor speed is reduced, *i.e.* 100 gal./sec. at $2\frac{1}{2}$ m.p.h., 40 lb./sq. in.

The unit is supplied complete with a pressure-regulator valve, pressure gauge and the Dorman-patented positive and fully-automatic anti-drip device.

'Handyloader'

Mitchell, Colman and Co. Ltd. have announced that a new light-weight auger-type grain loader is shortly going into production. The weight of the machine is about 40 lb. and is constructed with 4-in.-dia. tubing. The 'Handyloader' is the light-weight innovation of the 'Spirolift' and it is made in 9-ft., 12-ft. and 15-ft. lengths.

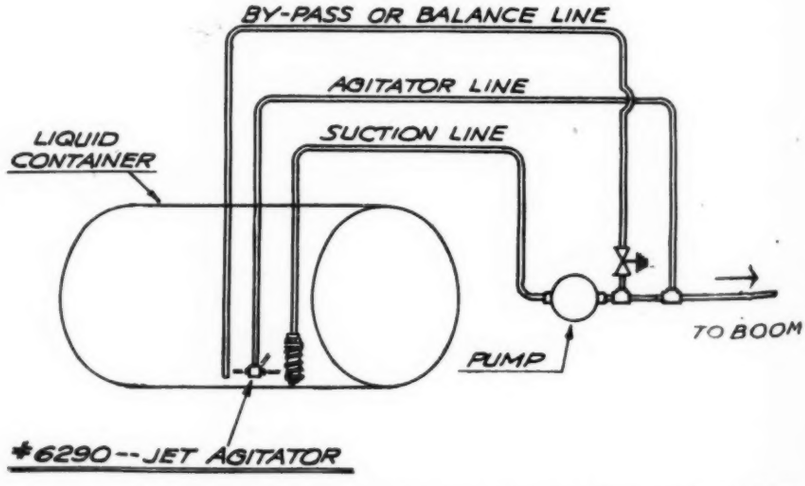
The basic unit is 9 ft. long and extensions can be fitted up to the maximum length, these being 3 and 6 ft.

The power required by the machine depends, of course, on the duty, but fractional-horsepower-driven units can be used in most cases. A special attachment will be supplied for driving the auger by means of a $\frac{1}{3}$- to $\frac{1}{2}$-h.p. electric drill. These drills are found on most farms and will therefore help towards the utmost economy.

New Jet Agitator Nozzle

Many chemicals used in farm spraying tend to settle apart in the drum during the spraying operation in spite of the movement of the tractor or rig as it moves across a field. This is particularly true where wettable powders are used. To maintain a proper mix, Spraying Systems Co., Bellwood, Illinois, U.S.A., has designed the No. 6290 jet agitator nozzle, which is positioned near the bottom of the drum. Liquid is sprayed in three directions, creating a random agitation pattern that continuously maintains an equalised distribution of chemicals. Design of the nozzle prevents the setting up of eddy currents and whirlpool action that could hinder the mixing process. The nozzle has been field-tested with a variety of solutions and has proved effective.

Illustrated schematically is a typical installation of the nozzle. A take-off line below the pump feeds part of the solution back into the drum. The liquid is ejected at high velocity from the agitator nozzle toward both ends of the drum and laterally to one side. In this manner the entire content of the drum is kept in random turbulent motion and a proper mix is maintained. Jet agitator nozzles are supplied in a range of capacities to meet the requirements of all drum sizes and chemicals. In addition, nozzles are supplied in a choice of all brass, brass with stainless steel caps, and in all aluminium as required by the chemicals used.



Schematic diagram of typical installation of jet agitator nozzle in drum Take-off line below pump recirculates part of the solution to agitator nozzle

WORLD CROP REPORTS

GENERAL

Tea. The salient feature of the world tea economy in 1954 was the great rise in prices. Although output rose in all important producing countries, except Pakistan, between January 1954 and January 1955, prices increased by about 50%, which brought them to an exceptionally high point.

World production in 1954 is currently estimated at 630,000 metric tons, as compared with 595,000 in the previous year, and an average of 603,000 tons during the three years 1951-53. Production declined in 1953, partly because of unfavourable weather conditions in some areas, and partly because of a decision by an association of Indian planters to restrict plucking in order to raise prices, which had declined sharply in the previous year. However, in 1954 production rose in almost all areas. Notwithstanding unfavourable weather conditions in Assam, total Indian production rose slightly. Ceylon, a member of the International Tea Committee, and subject to the controls which limit exports to 135% of standard exports (1929-31) and restrict planting and replants, has continued its marked post-war trend of increasing production, with a rise of 7% in 1954. In Indonesia, estate production, which had suffered severely from adverse weather in the previous year, rose by 25%.

However, the moderate production increases were not sufficient to stem the rise in prices that began in 1953. Firstly, carry-over stock from 1953 was very low. Secondly, increased demand developed in almost all consuming countries. Net imports into the United Kingdom rose by 10%, as compared with 1953, and *per caput* consumption, which had been kept down by rationing, rose above the pre-war level to around 4.6 kg., as compared with 4.2 in 1934-38 and 3.9 in 1950-52. Imports were higher also for the United States, Canada, Australia, New Zealand, Ireland and the main European consuming countries, notably the Netherlands and Germany. Although it is probable that the steep price increase in the second half of the year slowed down imports into some countries, world imports in 1954 are likely to be 20,000 to 30,000 metric tons higher than in 1953.

Prices and stocks. From January 1954 to January 1955 Calcutta export prices rose by 39% and domestic prices (for tea dust) by 30%; in Colombo the increase amounted to 47%. Even more steep was the rise in export duties levied by the Governments of India and Ceylon. The average increase amounted to 165%; this explains the greater rise in London auction prices (by 65%) than in Colombo or Calcutta. Indicative of the strength of demand is the fact that common filler teas rose much more than high-quality teas.

In comparison with 1934-38, London auction tea prices have risen from 13.8d. to 84.1d. in January 1955, which is almost double the average rise in the United Kingdom wholesale price index.

Inevitably there was throughout the year a time lag between the rising wholesale prices and prices paid by the ultimate consumers. In the United Kingdom, which absorbs about 46% of world imports, retail prices were raised repeatedly and, at the end of the year, were at least 50% higher than on January 1, 1954. The New Zealand Government has announced its intention to institute price control, while Australia and Ireland have begun to subsidise consumption.

Developments in producing countries. The easy disposal of all available tea at high prices made 1954 a remarkably prosperous year for the tea industry. Companies were able to replenish their reserves and to use profits for investment purposes. At the same time, all earlier wage cuts in India have been made good and wage increases took place in Ceylon and Pakistan. The Indian export duty was raised from 4 to 10 annas per lb. and the export cess was doubled. Export earnings of tea were one of the main assets in India's balance of payments in the first half of the financial year 1954-55. In Ceylon the increase was even bigger with a rise in the export duty from 45 cents to 1.30 rupee per lb. A special export tax will be levied on Indonesian tea in the first quarter of 1955. In Pakistan, however, tea exports are still exempt from duty. Strong Government interest was manifest in other directions. A Plantation Enquiry Commission was set up in India to investigate all aspects of plantation industries, comprising tea. The wish further to strengthen the Far Eastern auctions led to the establishment of an Auction Committee, designed to explore the possibilities of centralising all tea auctions in India and Ceylon.

Outlook. Assuming normal weather conditions, some increase in production can be anticipated in 1955. The supply position will remain tight until the summer months, when the new crop moves into trade channels, but high prices have undoubtedly affected consumption, especially in the United Kingdom, and trade demand may be further reduced by destocking at all steps of the distribution ladder.

Mon. Bull. Agric. Econ. Statist.

TABLE 1

TEA: PRODUCTION IN MAIN PRODUCING COUNTRIES (EXCLUSIVE OF CHINA AND U.S.S.R.) AVERAGE 1934-38, 1948-50, 1951-53, ANNUAL 1953 AND 1954

(1,000 metric tons)

Region	1934-38	1948-50	1951-53	1953	1954*
India	†178.0	267.6	290.9	275.7	288.0
Ceylon	103.9	140.2	149.1	155.6	166.0
Indonesia	74.8	25.2	40.2	36.8	46.0
Pakistan	†25.6	21.9	24.5	25.3	24.0
Japan	49.3	33.4	52.7	57.0	—
Other Asia‡ ..	23.9	16.1	20.6	15.3	22.0
Total Asia ..	456.0	505.0	578.0	570.0	600.0
Africa	9.0	18.0	21.0	22.0	27.0
South America ..	—	2.0	3.0	3.0	3.0
Total World ..	466.0	525.0	603.0	595.0	630.0

*Provisional. †1936-38. ‡Including Viet-Nam, Taiwan, Iran and Malaya.

CANADA

Wheat. If farmers' current plans are realised, wheat acreage in Canada in 1955 will register the third consecutive annual decrease. On the basis of farmers' intentions at March 1, the acreage seeded to spring wheat will be slightly less than 23 million acres, a decrease of 600,000 acres from 1954. An indicated decrease of 840,000 acres in Saskatchewan is almost entirely responsible for this year's lower acreage, considerably more than offsetting increases planned in Manitoba, Alberta and British Columbia.

The combined acreage of spring and winter wheat, at 23.6 million acres, will, if realised, be the smallest since 1945 and will be about 10% below the five-year (1949-53) average of 26.3 millions. Ontario's winter wheat acreage, based on the preliminary estimate issued last November, is placed at 639,000 acres. The relatively small amount of winter wheat grown in other provinces is included with spring wheat for the purpose of these estimates.

Oats for grain, barley and mixed grains. Increases are indicated in the acreages to be seeded in 1955 to each of the three major feed grains. The area intended for oats for grain, at 11.2 million acres, is up 10% from 1954 and is virtually the same as the five-year average. Increases are indicated for all provinces except Prince Edward Island, where a decrease of 3% is expected, and Quebec, where there is no change.

A record barley acreage of 9.8 million acres is in prospect for 1955. An area of the size currently indicated would be about 25% higher than last year's area of 7.9 millions, 30% above the five-year average of 7.6 millions, and 10% above the previous record of 8.9 millions in 1953. The major part of the overall indicated increase of almost 2 million acres is in Saskatchewan, where intended barley acreage is up by almost 1.3 million acres or 56% over last year's total. Increases are also intended in Alberta, Manitoba and Ontario. Moderate decreases are indicated in each of the Maritime Provinces and Quebec, while no change is indicated in British Columbia.

An overall increase of less than 2% is indicated for mixed grains, with the area currently placed at 1.7 million acres. Increases are indicated in each of the Prairie Provinces and in Prince Edward Island and Nova Scotia. However, no change is in prospect in Ontario, which accounts for 68% of the total area, nor in New Brunswick, while decreases are anticipated in Quebec and British Columbia.

Flaxseed. With the exception of Ontario, where a decrease of 5% is indicated, moderate to substantial increases in flaxseed acreage are in prospect in each of the flax-growing provinces. The indicated total of almost 1.7 million acres is 38% above last year's area, is double the five-year average of 828,000 acres, and is the highest since 1948. Prospective increases range from 10% in British Columbia to 64% in Saskatchewan.

Soya beans. The soya-bean acreage intended for 1955 in Ontario, the only province growing this crop on a commercial scale, is placed at 242,000 acres, a decrease of about 5% from last year's 254,000 acres. If this decrease materialises, it will be the first time since 1944 that soya-bean acreage in the province has failed to register an increase.

Potatoes. With the exceptions of Ontario, Saskatchewan and British Columbia, where no change is in prospect, slight to moderate increases are planned for potato acreages in 1955. The all-Canada total, currently placed at 309,000 acres, is 4% above the 1954 level, but about 7% under the 1949-53 average of 332,000 acres.

Dominion Bureau of Statistics.

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on April 1, 1955, have been reported by the Ministry of Agriculture.

In most areas conditions were unfavourable for cultivations and sowing until the middle of the month, when good progress was made on the lighter soils. Autumn-sown corn has been checked by frost and is generally backward.

The first two weeks of March were generally cold with snow showers and frequent night frosts. Milder conditions set in about the middle of the month, but lasted only a few days. Colder weather returned and prevailed until the 23rd, when conditions became milder for a short period with heavy rain, causing flooding in many parts of the country. The last few days of March were cold and mainly dry.

Autumn-sown crops. Wheat has been checked by frost and in several areas has suffered some damage by flooding or waterlogging. On the whole, the crop is backward, but some improvement took place towards the end of the month.

Barley was badly checked by frost in most areas and some redrilling is necessary.

Oats suffered damage by frost and waterlogging and are generally backward.

Rye withstood the severe weather well and is generally satisfactory, although backward.

Beans for stockfeeding suffered a severe check by frost, but reports from many areas indicate that crops should recover.

Spring cultivations and sowing. In most areas very little work was possible until conditions became more favourable about the middle of the month, when good progress was made on the lighter soils. Most of the heavier soils have been too wet to work and cultivations generally are still in arrears.

Except in some northern districts and parts of Wales, satisfactory progress was made with sowing on lighter soils, where good seed beds were obtained. Some progress was also made on early ploughed heavy land, but generally heavy soils have been difficult to work. Very little had germinated by the end of the month.

Potato planting and sugar beet. In most areas the preparation of land for potato planting is less forward than usual. Some progress was made with the planting of early varieties, but generally this work is in arrears.

The preparation of land for the cultivation of sugar beet is less forward than usual, but a little sowing has been done in some eastern areas.

Small losses by wet rot and frost are reported from a few areas for potato stocks, but on the whole potatoes remaining in clamps were generally in good condition.

Pastures. Leys sown last spring and summer are generally satisfactory, but have made very little growth owing to the cold weather. Other leys were also slow to make growth.